

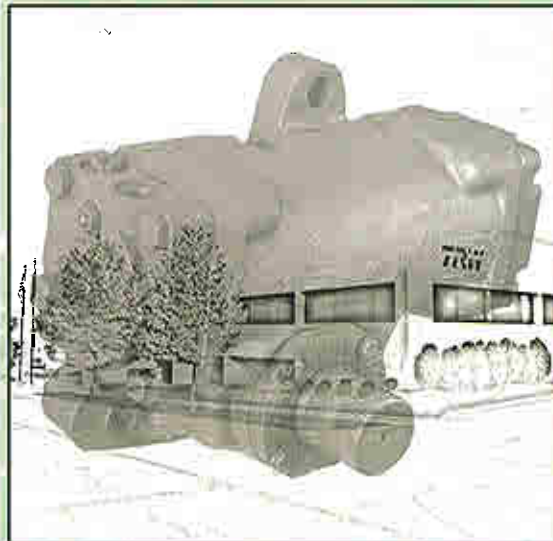
TRW Automotive

Commercial Steering Systems



HFB Steering Gear Service Manual

HFB52 SERIES



Definitions

NOTE: A NOTE gives key information to make a procedure easier or quicker to follow.

CAUTION: A CAUTION refers to those procedures that must be followed to avoid damage to a steering component or the gear.

WARNING: A WARNING REFERS TO THOSE PROCEDURES THAT MUST BE FOLLOWED FOR THE SAFETY OF THE DRIVER AND THE PERSON INSPECTING OR REPAIRING THE GEAR.

Disclaimer

This Service Manual has been prepared by TRW Ross Gear Division for reference and use by mechanics who have been trained to repair and service steering components and systems on heavy commercial vehicles. TRW Ross Gear Division has exercised reasonable care and diligence to present accurate, clear and complete information and instructions regarding the techniques and tools required for maintaining, repairing and servicing the complete line of TRW Ross Gear HFB52 Integral Power Steering Gears. However, despite the care and effort taken in preparing this general Service Manual, TRW **makes no warranties** that (a) the Service Manual or any explanations, illustrations, information, techniques or tools described herein are either accurate, complete or correct as applied to a specific HFB52 steering gear, or (b) any repairs or service of a particular HFB52 steering gear will result in a properly functioning steering gear.

If inspection or testing reveals evidence of abnormal wear or damage to the HFB52 steering gear or if you encounter circumstances not covered in the Manual, STOP - CONSULT THE VEHICLE MANUFACTURER'S SERVICE MANUAL AND WARRANTY. DO NOT TRY TO REPAIR OR SERVICE AN HFB52 STEERING GEAR WHICH HAS BEEN DAMAGED OR INCLUDES ANY PART THAT SHOWS EXCESSIVE WEAR UNLESS THE DAMAGED AND WORN PARTS ARE REPLACED WITH ORIGINAL TRW REPLACEMENT AND SERVICE PARTS AND THE UNIT IS RESTORED TO TRW'S SPECIFICATIONS FOR THE HFB52 STEERING GEAR.

It is the responsibility of the mechanic performing the maintenance, repairs or service on a particular HFB52 steering gear to (a) inspect the steering gear for abnormal wear and damage, (b) choose a repair procedure which will not endanger his/her safety, the safety of others, the vehicle, or the safe operation of the vehicle, and (c) fully inspect and test the HFB52 steering gear and the vehicle steering system to insure that the repair or service of the steering gear has been properly performed and that the steering gear and system will function properly.

Patents

This TRW Ross Gear Division vehicle power steering gear is covered by one or more of the following United States patent numbers: 3,896,702; 3,606,819; 3,741,074; 3,773,081; 3,955,473; 3,935,790; and 3,921,669. Other United States patent applications are pending, and corresponding foreign patents are pending or issued.

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WARNING: ALL STEERING MECHANISMS ARE LIFE AND LIMB ITEMS. AS SUCH, IT IS IMPERATIVE THAT THE INSTRUCTIONS IN THIS BOOKLET ARE FOLLOWED TO THE LETTER. FAILURE TO OBSERVE THE PROCEDURES SET OUT IN THIS PAMPHLET MAY RESULT IN LOSS OF STEERING.

Introduction

Service Manual for Model HFB52

This service manual has one purpose: to guide you in maintaining, troubleshooting, and servicing the HFB52 Hydrapower™ integral power steering gear.

Material in this manual is organized so you can work on the HFB52 and get results without wasting time or being confused. To get these results, you should review the contents of this manual before you begin any work on the HFB52.

The section of this manual on General Design and Operation, treats the major parts of the HFB52 and explains how they function together. The knowledge you acquire from reviewing this section should assist you in solving your steering problem.

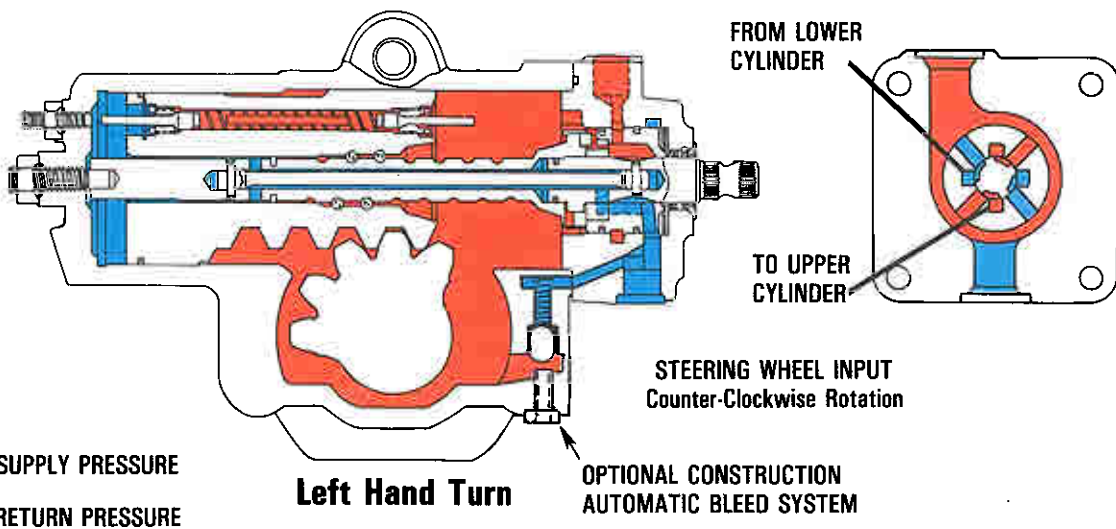
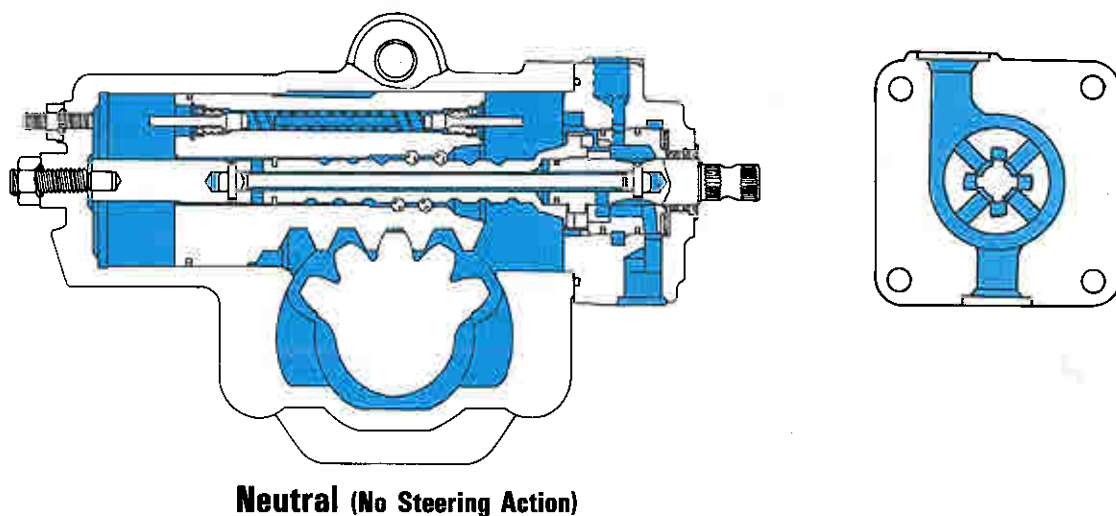
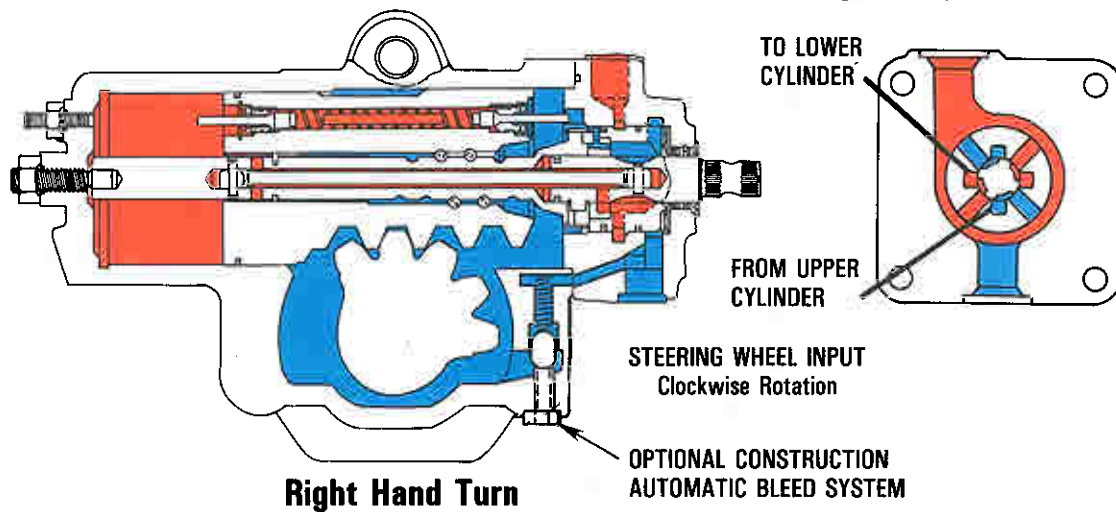
This manual also contains troubleshooting information and checklists. With them, you can diagnose a steering problem without removing the HFB52 from the vehicle. If you must service the HFB52, the checklists will help you to determine where the problem may be.


The three-column format of the Repairs, Adjustments, Disassembly, Inspection and Assembly sections will make it easier for you to service the HFB52. Column 1 gives a brief key for each procedure. Column 2 explains in detail the procedure you should follow. Column 3 illustrates this procedure with photographs. Pay special attention to the notes, cautions, and warnings.


A foldout page with a typical HFB52 exploded assembly view is provided in this manual. The component part names and item numbers assigned on this exploded assembly view correspond with names and item numbers (in parentheses) used in the disassembly, assembly and other procedures set forth in this manual. When this exploded assembly view page is folded out, you can easily identify components and locate their relative position on the exploded assembly view as you follow the disassembly, assembly and other procedures.

As you gain experience in servicing the HFB52, you may find that some information in this manual could be clearer or more complete. If so, let us know about it. Don't try to second guess the manual; if you are stuck, contact us. Servicing the HFB52 should be a safe and productive procedure.

HFB 52 Oil Flow Illustration



 SUPPLY PRESSURE

 RETURN PRESSURE

HFB52: General Design and Operation

Design

Integral Power Steering

The HFB52 power steering gear is the latest design in the Ross family of integral hydraulic power steering gears. Integral hydraulic power steering means that the gear box contains a manual steering mechanism, a hydraulic control valve, and a hydraulic power cylinder, all in a single, compact package.

Rotary Control Valve

The rotary control valve combines simplicity of construction with desirable performance characteristics. The speed at which the driver can turn the steering wheel with power assist is dependent upon the pump flow (measured in gallons per minute—gpm or Liters/Min.) directed to a cylinder cavity.

The pressure (measured in pounds per square inch—psi or bar) required for the gear to steer the vehicle is created by the power steering pump to overcome resistance at the steered wheels. The control valve senses these requirements and directs fluid to the cylinder cavity at the proper flow rate and pressure.

Pressure Means Work, Flow Means Speed

The higher pressure a gear can withstand, the more work it can perform. The HFB52 can steer a vehicle with a front-end weight rating of about 9,000 pounds (4082.4 Kg) through a turn at low vehicle speed and engine idle. As the driver turns the steering wheel faster or slower, more or less fluid will be required by the gear in one minute. For the HFB52, maximum operating pressure is 2000 psi (137.9 bar), maximum flow rate 6 gpm (22.7 Liters/Min.). **NOTE: The recommended minimum flow at 1½ hand wheel turns/second must be no less than 2 gpm (7.6 Liters/Min.). If the HFB52 steering gear is controlling an auxiliary cylinder, increased minimum flow is required based on the size of the auxiliary cylinder and the vehicle's steering geometry.**

Operation

What Happens During a Steering Maneuver

When the driver turns the steering wheel, he transmits force from the wheel to the steering gear input shaft. A torsion bar, pinned at its one end to the input shaft and at its other end to the worm shaft, turns with the input shaft and exerts a rotational force on the worm shaft. In response to this rotational force, the worm shaft, acting through the recirculating ball mechanism, tries to move the rack piston axially through the gear housing cylinder bore.

The rack piston's axial movement is resisted by its engagement to the sector shaft, which is connected by linkage to the steered wheels. Because of this resistance, the torsion bar is twisted by the input shaft, thereby actuating the control valve. Pressurized fluid, directed by the control valve, assists in moving the rack piston axially through the cylinder bore. The rack piston then turns the sector shaft to steer the vehicle.

Shock Loads to the Gear

If the steered wheels receive a shock load, the shock forces are transmitted through the sector shaft, to the rack piston, and onto the worm shaft. The internal geometry of the steering gear causes the control valve to send high-pressure fluid to the correct cylinder cavity to resist the shock forces. By absorbing the shock forces hydraulically, the steering gear prevents objectionable kickback at the steering wheel.

Unloading (Poppet) Valves

Some HFB52 gears are equipped with two unloading valves, one at each end of the rack piston. One valve or the other, depending on the direction of turn, will trip as the steered wheels approach the axle stops (which must be set according to manufacturer's specification). The tripped valve reduces pressure in the gear and helps to reduce heat generated by the pump. At the same time, the valves also reduce forces on the steering linkage.

Relief Valve

Some HFB52 gears, whether equipped with or without poppets, are also supplied with a relief valve. The relief valve limits maximum supply pressure to protect the power steering pump, but it does not reduce pressure as the steered wheels approach the axle stops.

Bleed Systems

Some HFB52 gears which are mounted with the output shaft above the rack piston bore are equipped with either an automatic bleed system or a manual bleed screw.

The procedure for servicing the manual bleed screw is described under "Filling and Air Bleeding" (page 47) in this manual.

If the unit has an automatic bleed system, illustrated as optional on the oil flow diagram, no servicing is required on the vehicle.

Troubleshooting Information

Preliminary Checks

When a customer comes to you with a problem related to his truck's steering, you can save a lot of time and work if you first verify the problem. Make sure you're both talking the same language about the same problem. If he says the truck's hard to steer, find out exactly what he means. Is it hard steering into a right or left turn? Only when turning the steering wheel while the truck is sitting still? Is there only intermittent power steering? Or is there no power assist at all?

If at all possible, and if it's safe to do so, test drive the truck. If you're not familiar with the rig, let the customer drive it while you sit beside him. Take hold of the wheel while he drives to get a feel for the problem he's talking about. Since most of his driving will be with his truck hauling a load; arrange for a load if one is required to reproduce the steering problem.

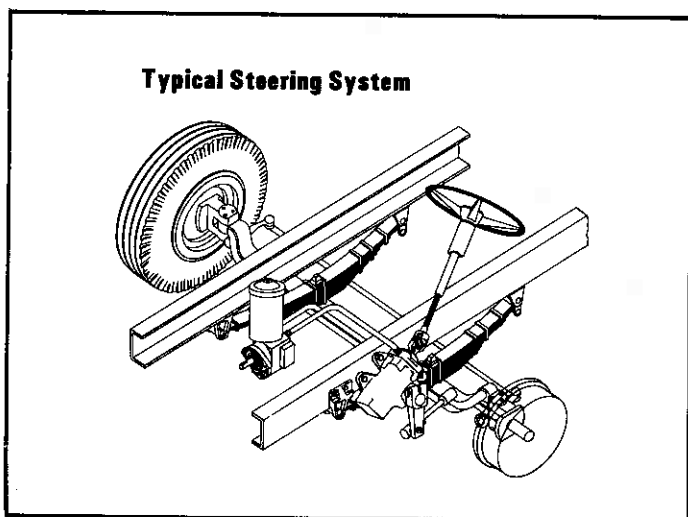


Figure 1

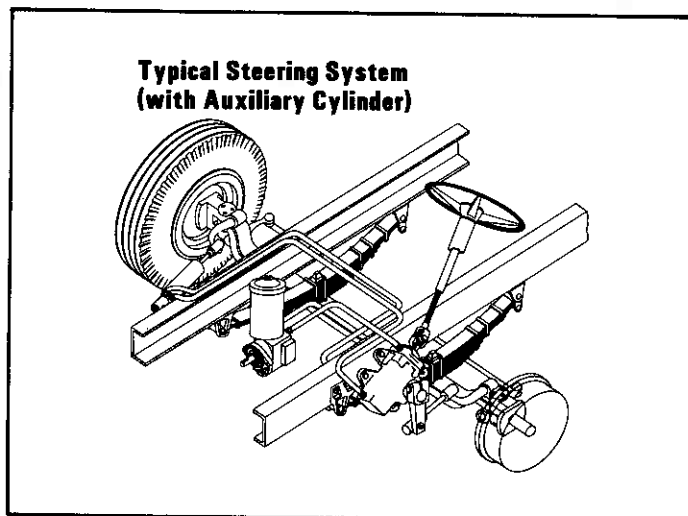


Figure 1A

Once you've determined the problem and its symptoms, don't jump right in to tear the steering gear or pump apart. In most

cases, in fact, the gear should be the last component you check. There are many other components in the steering system that could be causing the problem (see FIG. 1 & 1A). These you should check first.

Begin, then, by checking the steered wheels: make sure that the tires are at correct pressure and equal all around, that they are properly sized, and that they are not worn or damaged.

Next, have the front-end alignment checked and look for abnormal looseness or tightness in the steering linkage, ball joints, and king pins.

A service replacement hose or fluid line may be misrouted or may be too small in diameter, or it may be restricted in some other way. Reroute any hose that is kinked or bent sharply. Replace any hoses that are not the same as original equipment.

Continue by checking the power steering fluid reservoir to make sure that oil is up to the correct level. Also, check the pump drive belt, if one is used, to see if it is slipping. The belt may be tight, but it may also be glazed, and a slipping belt doesn't always squeal. If you adjust the belt, check the specifications.

These are just some of the checks you should make before you turn to the steering gear or pump. The Troubleshooting Guide on pages 8 thru 10 explains what to diagnose for a particular steering problem. Match the trouble symptom against the chart and follow the recommended troubleshooting sequence. Doing so will most likely save you time and may prevent unnecessary repairs and costs.

Hydraulic Tests

If the checks described above all prove satisfactory, it is possible that the cause of the steering problem can be traced to a lack of pressure or insufficient flow. In this case, you may have to do more detailed troubleshooting that involves conducting hydraulic tests.

Preparation for Hydraulic Tests

To conduct the following hydraulic tests, first install a flow meter, pressure gage and load (shut off) valve in the fluid supply line to the steering gear, as indicated by the instructions that come with the flow meter. Steering system analyzers are available with the 3 units integral. Place a thermometer in the reservoir (FIG. 2). You must use a flow meter, and it is recommended that you use a thermometer, if you are to troubleshoot the hydraulic system accurately.

Start the engine and warm the hydraulic system up by partially closing the load valve until the pressure gage reads 1000 psi (69.0 Bar). When the fluid temperature, as indicated on the thermometer, reaches between 125°F (51.7°C) and 135°F (57.2°C), open the load valve. The system is warmed up, and you can conduct the tests.

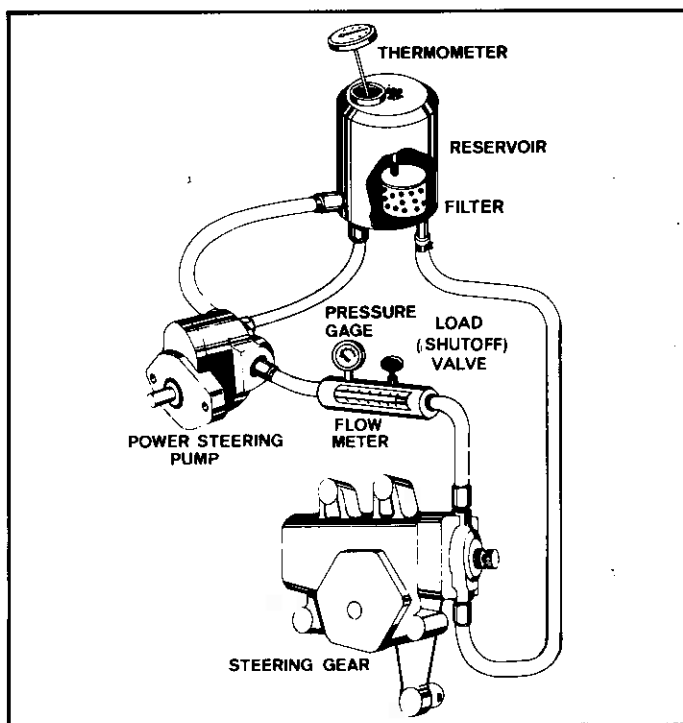


Figure 2

CAUTION: Do not close the load valve completely and leave it closed, or you may damage the pump. At no time allow fluid temperature to exceed 180°F (82.2°C). Run all the tests at the prescribed temperature range of 125°F (51.7°C)-135°F (57.2°C).

Power Steering Pump Pressure Test

With the engine idling, close the load valve and read the pressure gage. If the pressure reads below the minimum specified by the pump manufacturer, repair or replace the pump.

CAUTION: Do not keep the load valve closed for longer than 5 seconds to avoid damaging the pump. Closing the load valve causes the pump to operate at relief pressure and the fluid temperature to increase rapidly. Allow fluid to cool between 125°F (51.7°C) and 135°F (57.2°C) before you resume with the other tests.

Power Steering Pump Flow Test

WARNING: MAXIMUM FLOW RATE FOR THE HFB52 STEERING GEAR IS 6 GPM (22.7 LITER/MIN). FLOW RATE SHOULD NOT EXCEED 6 GPM (22.7 LITER/MIN). EXCESSIVE FLOW CAN CAUSE DAMAGE TO INTERNAL PARTS OF THE STEERING GEAR, WHICH COULD RESULT IN A LOSS OF POWER STEERING.

NOTE: If flow specifications and methods of checking flow rate are provided by the vehicle manufacturer, you should follow those instructions rather than the procedure described below.

With the engine idling and the fluid temperature between 125°F (51.7°C) and 135°F (57.2°C), check the pump manufacturer's specifications for flow rate. Compare these specifications with the flow rate on the flow meter.

Now, fully close the load valve until the pressure gage registers the pressure at which the pump is relieving. When pump relief is reached, flow rate must be zero. **IMMEDIATELY OPEN THE LOAD VALVE.** The flow rate must instantly return to the original reading. If this rate does not return immediately, the pump is malfunctioning, which can result in intermittent power assist.

Now, set the engine at governed rpm, and fully close the load valve again until pump relief is reached. At pump relief, the flow rate must be zero. **IMMEDIATELY OPEN THE LOAD VALVE.** The flow rate must instantly return to the original reading. If this rate does not return immediately, the pump is malfunctioning, which can result in intermittent power assist.

NOTE: Conduct the pump flow test once at idle rpm and three times at governed rpm.

CAUTION: Do not allow the fluid temperature to exceed 180°F (82.2°C). Run each phase of this test between 125°F (51.7°C) and 135°F (57.2°C).

Steering Gear Internal Leakage Test

To test the steering gear for internal leakage, you must first prevent operation of the gear's internal unloading (poppet) valves or relief valve (or both, in some gears). This will allow full pump relief pressure to develop. To prevent operation of the poppets, place an unhardened steel spacer block, about 1 inch thick and long enough to keep your fingers clear, between the axle and stop at one wheel (see FIG. 3). To prevent operation of the relief valve, remove the relief valve by following disassembly step 16. Install the relief valve plug, special tool J29059, in its place.

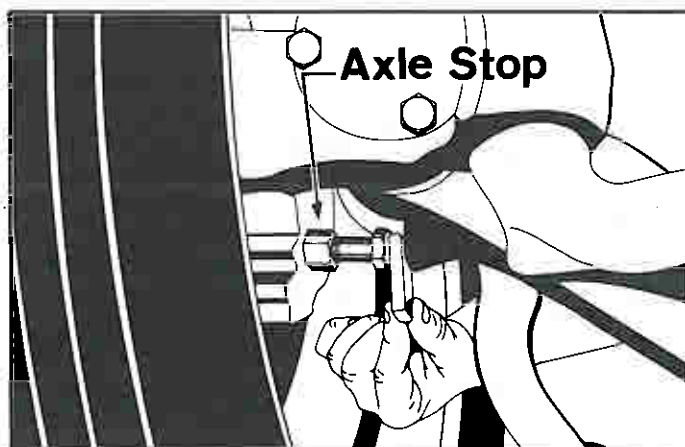


Figure 3

NOTE: Be sure you reinstall the relief valve, with new seals and O-rings, back onto the gear. Follow assembly step 24.

With the fluid temperature between 125°F (51.7°C) and 135°F (57.2°C), turn the steering wheel until the axle stops bottom on the spacer block (FIG. 3).

CAUTION: When running this test, do not hold the steering wheel in the full turn position for longer than 5 to 10 seconds at a time to avoid damaging the pump.

WARNING: KEEP YOUR FINGERS CLEAR OF THE AXLE STOPS AND SPACER BLOCK DURING THIS TEST. MAKE SURE THAT THE SPACER BLOCK CONTACTS THE AXLE STOP SQUARELY. CONTACT THAT IS NOT SQUARE COULD BREAK THE AXLE STOPS OR DANGEROUSLY THROW OR EJECT THE SPACER BLOCK.

Apply 20 lbs. (9.1 KG) to the rim of the steering wheel during this test to be sure that the steering gear control valve is fully closed. The pressure gage should now read pump relief pressure, as noted during the pump pressure test. You can now read steering gear internal leakage on the flow meter.

Acceptable internal leakage can range from 0 to 1.5 gpm. (5.7 Liters/Min.)

Repeat this test for the opposite direction of turn.

If internal leakage is greater than 1.0 gpm (3.8 Liters/Min.) and there is an auxiliary hydraulic cylinder in the system, repair the gear. If the internal leakage is greater than 1.5 gpm (5.7 Liters/Min.) and there is an auxiliary hydraulic cylinder in the system, controlled by the HFB52 gear, isolate the auxiliary cylinder from the system by disconnecting the auxiliary cylinder hydraulic lines at the HFB52 unit's auxiliary ports. Plug those ports with suitable pressure plugs or caps. Connect the disconnected lines together if a rotary auxiliary cylinder is in the system. Plug the disconnected lines if a linear auxiliary cylinder is in the system and disconnect the linear cylinder from the steering linkage, making sure it will clear the steered axle. Repeat the internal leakage test. If the internal leakage is less than 1.0 gpm (3.8 Liters/Min.), repair the auxiliary cylinder. If the internal leakage is greater than 1.0 gpm (3.8 Liters/Min.), repair the HFB52 gear. See internal leakage diagram (FIG. 4).

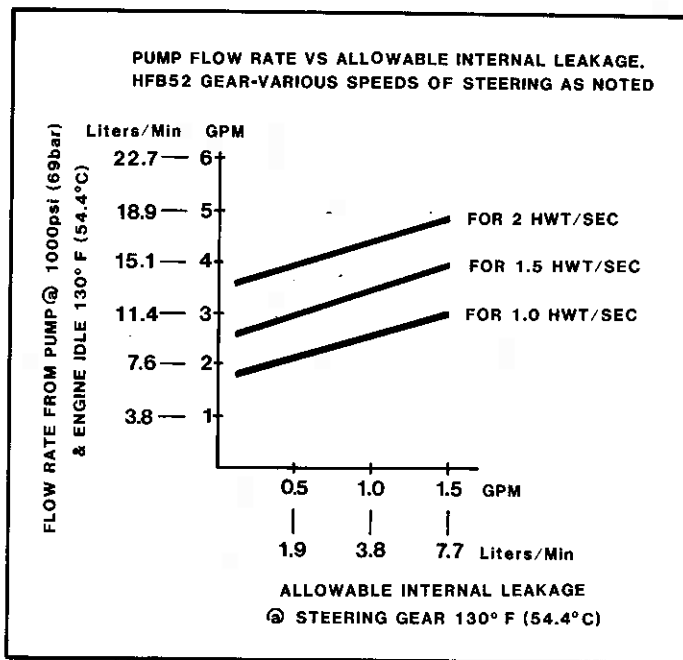


Figure 4

NOTE: When hydraulic tests are completed and fluid lines are reconnected, check fluid level and air bleed the system. Reference page 47.

NOTE: If all seals as included in the complete seal kit have been correctly replaced, and the HFB52 steering gear cannot pass the internal leakage test, or if intermittent loss of power steering occurs, a service worm shaft/input shaft, valve sleeve assembly is required.

Troubleshooting Guide

I. Normal Noises

- You or the driver may hear a hissing noise from the control valve when it is actuated during a steering maneuver.
- You or the driver may hear a noise as fluid bypasses through the poppets at full turn.
- You or the driver may hear a noise from the system relief valve when it is required to actuate.
- You or the driver may hear pump growl from some types of power steering pumps.

II. Abnormal Noises

- If the power steering pump is belt driven, a squealing noise may indicate that the belts should be tightened or replaced.
- A clicking noise heard during a turn, or when changing directions, may indicate that some component is loose and shifting under load.
- A change in the normal noise of the pump may indicate that air has been induced into the system or that fluid level is low.

III. Possible Steering Problems and Causes

Road Wander

- Tire pressure incorrect or unequal left to right.
- Components in steering linkage loose or worn (Steering wheel to road wheel).
- Wheel bearings improperly adjusted or worn.
- Front end alignment out of specification.
- Dry fifth wheel or poor finish on fifth wheel or trailer plate.
- Steering gear mounting bolts loose on frame.
- Steering gear improperly adjusted.
- Looseness in rear axle assemblies or trailer bogies.

No Recovery

- Tire pressure low
- Front end components binding
- Front end alignment incorrect
- Tight front axle king pins
- Dry fifth wheel or poor finish on fifth wheel or trailer plate
- Steering column binding
- Pump flow insufficient
- Steering gear improperly adjusted
- Steering gear control valve sleeve sticking

Shimmy

- Badly worn or unevenly worn tires
- Improperly mounted tire or wheel
- Wheel bearings improperly adjusted or worn
- Components in steering linkage loose or worn
- Wheels or brake drums out of balance
- Front end alignment incorrect
- Air in the hydraulic system

External Oil Leakage

- Finding the location of a leak may be difficult, since oil may run away from leak source, the fittings, hoses, pump, or gear to a low point on the gear or chassis.
- A leak from the vent plug at the side cover indicates failure of the sector shaft oil seal inside the side cover.

Oversteering or Darting

- Dry fifth wheel or poor finish on fifth wheel or trailer plate
- Front end components binding or loose
- Steering column binding

- Steering gear improperly adjusted
- Steering gear control valve sleeve sticking
- Rear axle mounts (rear steer)

High Steering Effort in One Direction

- Unequal tire pressure
- Vehicle overloaded
- Inadequate hydraulic system pressure
- Excessive internal leakage in one direction of turn only (verify with internal leakage test)

High Steering Effort in Both Directions

- Low tire pressure
- Vehicle overloaded
- Low hydraulic fluid level
- Low pressure or flow from pump
- Components of steering system binding
- Restriction in return line, or line too small in diameter
- Excessive internal leakage (verify with internal leakage test)
- Oversize tires (check manufacturer's specifications)

Lost Motion (Lash) at the Steering Wheel

- Steering wheel loose on the shaft
- Loose connection between the steering gear, intermediate column, and steering column
- Steering gear loose on frame
- Pitman arm loose on output shaft
- Components in steering linkage loose or worn
- Steering gear improperly adjusted

Excessive Heat [150°F (65.6°C) Over Ambient]. Not to Exceed 250°F (121°C) Continuously

- Excessive pump flow
- Vehicle overloaded
- Undersized replacement hose or line
- Restricted hose or line that is kinked or severely bent or internally blocked
- Restricted recentering of gear valve caused by column bind or side load on the input shaft
- Poppet not adjusted properly (only for gears equipped with poppets)
- Prolonged stationary vehicle operation

WARNING: IF THE HYDRAULIC SYSTEM FLUID BECOMES OVERHEATED, IT CAN CAUSE THE SEALS IN THE STEERING GEAR AND PUMP TO SHRINK, HARDEN, OR CRACK AND LOSE THEIR SEALING ABILITY.

Repairs and Adjustments on Vehicle

When you have conducted the checks and tests described in the troubleshooting sections, you may find it necessary to repair or adjust the steering gear. Since removing the gear from the vehicle is usually difficult and time-consuming, you will probably find it easier to perform the following repairs and adjustments with the gear on the vehicle. The photographs in this section show a gear mounted on a mock-up frame for clearer illustration.

1 The Sector Shaft Trunnion Seal

remove pitman arm

- 1.1 If you detect a leak in the sector shaft seal area, on many HFB52 installations you can remove the sector shaft seal package with the gear on the vehicle. First, remove the pitman arm (FIGS. 5 and 6). 15/16 inch box end or socket wrench required.

NOTE

NOTE: Use of a chisel to spread the boss will help you to loosen the pitman arm.

WARNING

WARNING: WHEN USING A CHISEL TO SPREAD THE PITMAN ARM BOSS IN ORDER TO LOOSEN THE PITMAN ARM FOR REMOVAL FROM THE SHAFT, MAINTAIN A FIRM GRIP ON THE CHISEL AT ALL TIMES. FAILURE TO DO THIS MAY RESULT IN THE CHISEL FLYING LOOSE WHICH COULD CAUSE AN INJURY. NEVER LEAVE THE CHISEL WEDGED IN THE PITMAN ARM BOSS. IF YOU CANNOT REMOVE THE PITMAN ARM FROM THE SHAFT WITH A CHISEL AND YOUR HANDS, REMOVE THE CHISEL FROM THE PITMAN ARM AND USE A PULLER ONLY TO REMOVE THE PITMAN ARM.

CAUTION

CAUTION: If the HFB52 unit being serviced has the alternate automatic poppet adjustor and sleeve assembly (19A) do not allow the input shaft (14) to rotate more than 1.5 revolutions from the straight ahead position while the pitman arm is removed as this could effect the automatic poppet adjustment necessitating the disassembly of steering gear and poppet adjustor to reset for automatic poppet adjustment. (See alternate poppet construction page 19B & 19C).

NOTE

NOTE: When the steering gear is in the "straight ahead position" the timing mark on the end of the sector shaft (42) will be perpendicular to the input shaft (14) and aligned with the timing mark on the end of housing (30) trunnion.

remove dirt and water seal

- 1.2 Remove and discard the dirt and water seal (37) (FIG. 7).

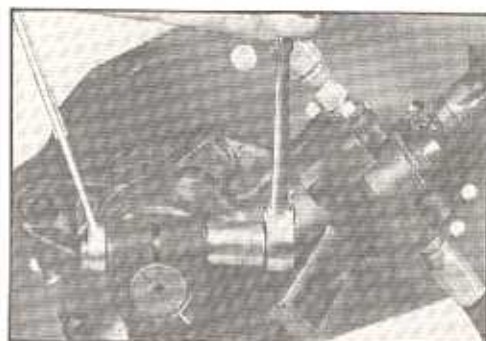


Figure 5



Figure 6



Figure 7



Figure 8

clean sector
shaft

- 1.3 Clean the sector shaft (42) with a fine grade of emery paper (FIG. 8). Be sure to remove any and all paint.

disconnect and
plug return
line

- 1.4 Clean the area around the return line port of H+852 gear. Disconnect the return line from the port and plug the return line.

remove

- 1.5 Remove retaining ring (36) using a screw driver to pry the end of the retainer loose (FIG. 9).



Figure 9

apply air
pressure to
return port

- 1.6 Hold a shop rag over the sector shaft (42) and housing (30) in the area where dirt and water seal was removed, and apply shop air pressure to valve housing return port (FIG. 10).



Figure 10

WARNING

WARNING: WEAR EYE PROTECTION AND BE SURE TO COMPLY WITH OSHA OR OTHER MAXIMUM AIR PRESSURE REQUIREMENTS.

remove seal,
and backup
washers

- 1.7 The air pressure will force the two piece seal (33), *Teflon back up washer (34) and steel backup washer (35) to pop out of the gear and fluid to leak from the gear (FIG. 11). Be prepared to, and stop the shop air pressure as soon as the seal and washers are free of the housing. Discard seal (33) and washer (34).



Figure 11

tape sector
shaft

- 1.8 Cover the serrations of the sector shaft (42) with one layer of masking tape to avoid damaging the seals during installation (FIG. 12).



Figure 12

install seal and washers

- 1.9 Apply clean grease to O.D. and I.D. of a new seal (33). Install the new seal with the side labeled "Oil Side" toward the housing (30), a new *Teflon back up washer (34) and the steel back up washer (35) into the housing using tool J26815 to push these parts into place (FIG. 13).

WARNING

WARNING: THE SIDE OF SEAL (33) LABELED "OIL SIDE" MUST BE TOWARD THE HOUSING. THE SEAL WILL NOT FUNCTION IF THE SEAL IS REVERSED AND A LOSS OF POWER ASSIST MAY OCCUR.



Figure 13

install retaining ring

- 1.10 Install retaining ring (36) making sure it is properly seated in the housing retaining ring groove (FIG. 14).



Figure 14

pack with grease and install new dirt and water seal

- 1.11 Pack the cavity around the seal area of sector shaft (42) with high temperature industrial grease per Russ specification D45231, *Mobil Temp 1 or 2 or equivalent. Install a new dirt and water excluder seal (37) using J26815 tool or a suitable blunt ended drift (FIG. 15). Remove the tape from the sector shaft serrations.



Figure 15

install pitman arm

- 1.12 Reconnect pitman arm, making sure that the timing mark on the pitman arm aligns with timing mark on the sector shaft (FIG. 16).

WARNING

WARNING: WHEN USING A CHISEL TO SPREAD THE PITMAN ARM BOSS FOR ASSEMBLY ONTO THE SECTOR SHAFT (42), MAINTAIN A FIRM GRIP ON THE CHISEL AT ALL TIMES. FAILURE TO DO THIS MAY RESULT IN THE CHISEL FLYING LOOSE WHICH COULD CAUSE AN INJURY. NEVER LEAVE THE CHISEL WEDGED IN THE PITMAN ARM BOSS.



Figure 16

install and torque pitman arm bolt

- 1.13 Insert the pitman arm clamp bolt and nut assembly, using a grade 8 bolt (FIG. 17). If the bolt is lubricated or plated, torque it to 160-180 ft. lbs. (217-244 N m). If it is dry and unplated, torque it to 220-240 ft. lbs. (298-325 N m).

CAUTION

CAUTION: Be sure there is no spreading wedge left in the pitman arm boss before torquing pitman arm clamp bolt.



Figure 17

reconnect return line

- 1.14 Unplug and reconnect return line to HF852 unit.

*Mobil Temp is a registered trademark of Mobil Oil Co.

fill and bleed
system

- 1.15 Before operating the steering gear, fill the system with the recommended fluid and bleed air from the system by following the Filling and Air Bleeding instructions on page 47.

2 The Worm Shaft/Input Shaft Seal

remove input
coupling; clean
input shaft

- 2.1 If there is a leak in the worm shaft/input shaft seal assembly (5 and 6), you can usually replace the seal assembly with the gear on the vehicle. Start by removing the input coupling and seal protector (61). (FIG. 18).

WARNING

WARNING: DO NOT DRIVE OR PRY COUPLING FROM WORM SHAFT/INPUT SHAFT. INTERNAL DAMAGE TO THE STEERING GEAR CAN RESULT. IF COUPLING IS TIGHT, INSERT SCREWDRIVER INTO SLOT TO RELEASE.

Clean the exposed area of the worm shaft/input shaft (14) with a fine grade of emery paper (FIG. 19). Be sure to remove any and all paint.

remove and
plug the return
line

- 2.2 Remove and plug the return line (FIG. 20).

remove seal

- 2.3 Remove and discard the dirt and water seal (2) (FIG. 21).

remove
retaining ring

- 2.4 Remove the seal retaining ring (3) from the valve housing (7) (FIG. 22).

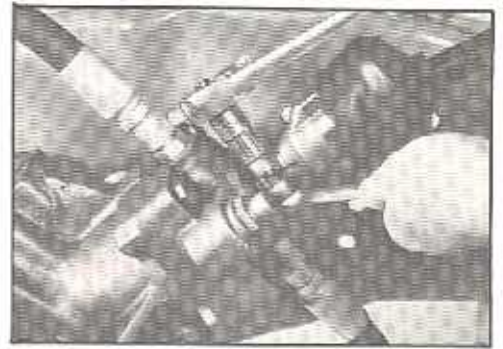


Figure 18



Figure 19



Figure 20



Figure 21



Figure 22

apply air
pressure to port

WARNING

- 2.5 Hold a shop rag over the worm shaft/input shaft (14) and apply shop air pressure to the valve housing (7) return port (FIG. 23).

WARNING: WEAR EYE PROTECTION AND BE SURE TO COMPLY WITH OSHA OR OTHER MAXIMUM AIR PRESSURE REQUIREMENTS.



Figure 23

remove seal and
washer

- 2.6 The air pressure will force the two-piece input shaft seal (5 and 6) and the steel backup washer (4) to pop out of the gear, and some fluid will leak from the gear (FIG. 24). Discard the two-piece seal. Disconnect the shop air as soon as the seal assembly is out.



Figure 24

install seal
package

- 2.7 Apply clean grease to the new worm shaft/input shaft seal assembly (6, 5) and to the worm shaft/input shaft (14) seal area. Install the new two-piece seal (6 and 5) flat side out and the steel backup washer (4), using seal driving tool J26653 (FIG. 25). Install the retaining ring (3) with the appropriate retaining ring pliers.



Figure 25

grease input
shaft

- 2.8 Pack the area around the worm shaft/input shaft (14) and dirt and water seal (2) cavity with high temperature industrial grease per Ross specification 045231, *Mobil Temp 1 or 2 or equivalent (FIG. 26).



Figure 26

install dirt and
water seal and
seal protector

- 2.9 Install the **new** dirt and water seal (2) onto the input shaft (14) with the part number facing out. Use tool J26654 or a suitable blunt-ended drift to press the seal into its counter bore. (Fig. 27) If the **new** seal has a sealing lip on the O.D., it must be against the valve housing (7) face. If the **new** seal does not have a lip on the O.D., the outer end of the seal must be flush with valve housing face. Apply more of the special grease to the cupped side of seal protector (61) and assemble over input shaft and against valve housing.



Figure 27

- reconnect line 2.10 Remove the plug and reconnect the return line.
- reconnect input coupling 2.11 Reconnect the input coupling. If the input coupling male assembly slides free of the female and during reassembly, realign the timing marks to insure proper phasing of the U-joints. Refer to vehicle manufacturer for recommended torque.
- WARNING** **WARNING: MISTIMED U-JOINTS CAN RESULT IN A BUMPY SENSATION AT THE STEERING WHEEL AND POSSIBLY AFFECT STEERING CONTROL.**
- fill and bleed system 2.12 Before operating the steering gear, fill the system with the recommended fluid and bleed air from the system by following the Filling and Air Bleeding instructions on page 47.

Adjustments

You can make three adjustments to the gear while it is mounted on the vehicle; the worm shaft preload adjustment, the poppet valve adjustment, if your gear is equipped with poppets, and the sector shaft adjustment.

3 Worm Shaft Preload Adjustment (With vehicle engine off)

- loosen sealing nut and adjusting screw 3.1 Back off the worm shaft adjusting screw sealing nut (41) three turns (FIG. 28). Back off the worm shaft preload adjusting screw (40) one turn (FIG. 29). Inspect the threads between the jam nut and housing end for foreign matter. Clean the threads or replace the sealing nut if necessary (FIG. 30). 7/8 inch box end and 1/4 inch Allen wrench required.
- torque adjusting screw 3.2 While someone lightly moves the steering wheel back and forth about one inch total, torque the worm shaft preload adjusting screw (40) to 25-30 in. lbs. (2.8-3.4 N m).



Figure 28



Figure 29

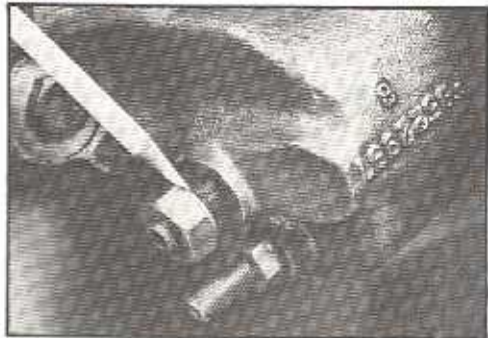


Figure 30

NOTE

NOTE: While torquing the adjusting screw, make sure that the worm shaft adjusting screw sealing nut (41) does not tighten (FIG. 31).



Figure 31

torque sealing nut

- 3.3 Torque the worm shaft adjusting screw sealing nut (41) to 40-50 ft. lbs. (54-68 N m) making sure that the worm shaft preload adjusting screw (40) does not move.

NOTE

NOTE: If the sealing material in the sealing nut has separated, remove the adjusting screw and replace the sealing nut with a new one onto the nonslotted end of the adjusting screw. Then, assemble and adjust the assembly as described.

4 Poppet Valve Adjustment

(With vehicle engine on)

NOTE

NOTE: This adjustment is for all HFB52 gears equipped with poppet (unloading) valves, except automatically set poppet valves, whether they are also equipped with a relief valve or not. Only the poppet on the lower end (closed end) of the housing is adjustable.

CAUTION

CAUTION: If the unit being serviced has the alternate automatically set poppet adjustor and sleeve assembly (19A) these poppet valve adjustment procedures do not apply. See pages 50 & 51 for automatic adjustment procedures.

set axle stops

- 4.1 Before you adjust the poppets, set the axle stops according to the manufacturer's specifications.

install flow meter

- 4.2 Install a pressure gage or a flow meter/pressure gage package into the supply line from the pump to the gear. Make sure that the flow meter can be pressurized. Bring the fluid temperature to between 125°F and 135°F (51.7°C and 57.2°C), using the method to warm the system up described in the troubleshooting section, page 7.

rotate sector shaft to position rack piston

- 4.3 To position the rack piston for poppet adjustment, observe the end of sector shaft (42) for direction of travel with the engine at idle. Have the steering wheel rotated in the direction that will rotate the sector shaft to the end of its travel (axle against axle stop) clockwise (CW) or counter-clockwise (CCW) as indicated by the shaft rotation arrow placed as shown in FIG. 32 or 33 and pointing toward the adjustable poppet and closed end of housing (30).

CAUTION

CAUTION: If relief pressure is reached while the steering wheel is at full lock (axle against axle stop), release the steering wheel from this position. At no time should relief pressure be maintained for longer than 5 seconds as damage to the pump may result.

NOTE

NOTE: You must maintain enough force on the steering wheel to assure that the steering gear control valve is completely closed when reading pressure gage.

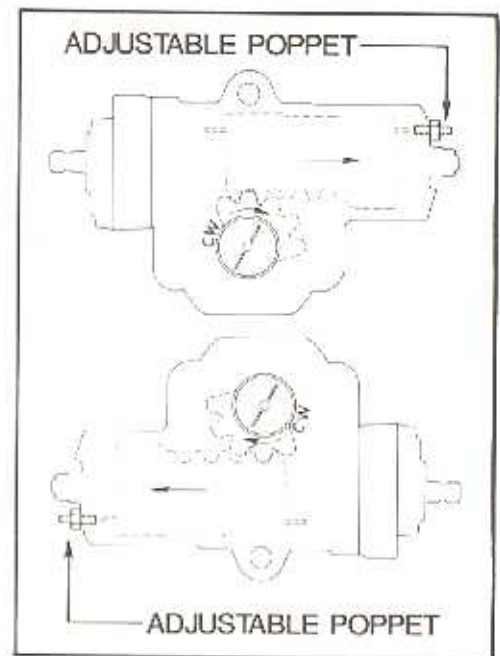


Figure 32

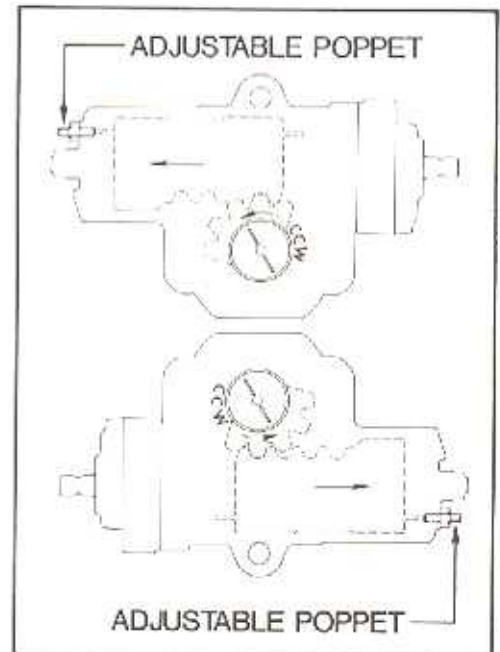


Figure 33

loosen sealing nut and adjusting screw

- 4.4 Once you have the steering wheel in full lock (axle against axle stop) in the correct direction, loosen the poppet adjusting screw sealing nut (39) and the poppet adjusting screw (38) until the pressure gage reads maximum pump relief pressure (FIG. 34). 11/16 inch box end and 1/4 inch Allen wrench required.

set adjusting screw & tighten sealing nut

- 4.5 Screw in the poppet adjusting screw (38) until the pressure gage shows a significant drop in pressure, 200-400 psi (13.8-27.6 Bar) with the steering wheel in full lock. Tighten the poppet adjusting sealing nut (39) to 12-18 ft. lbs. (16-24 N m).

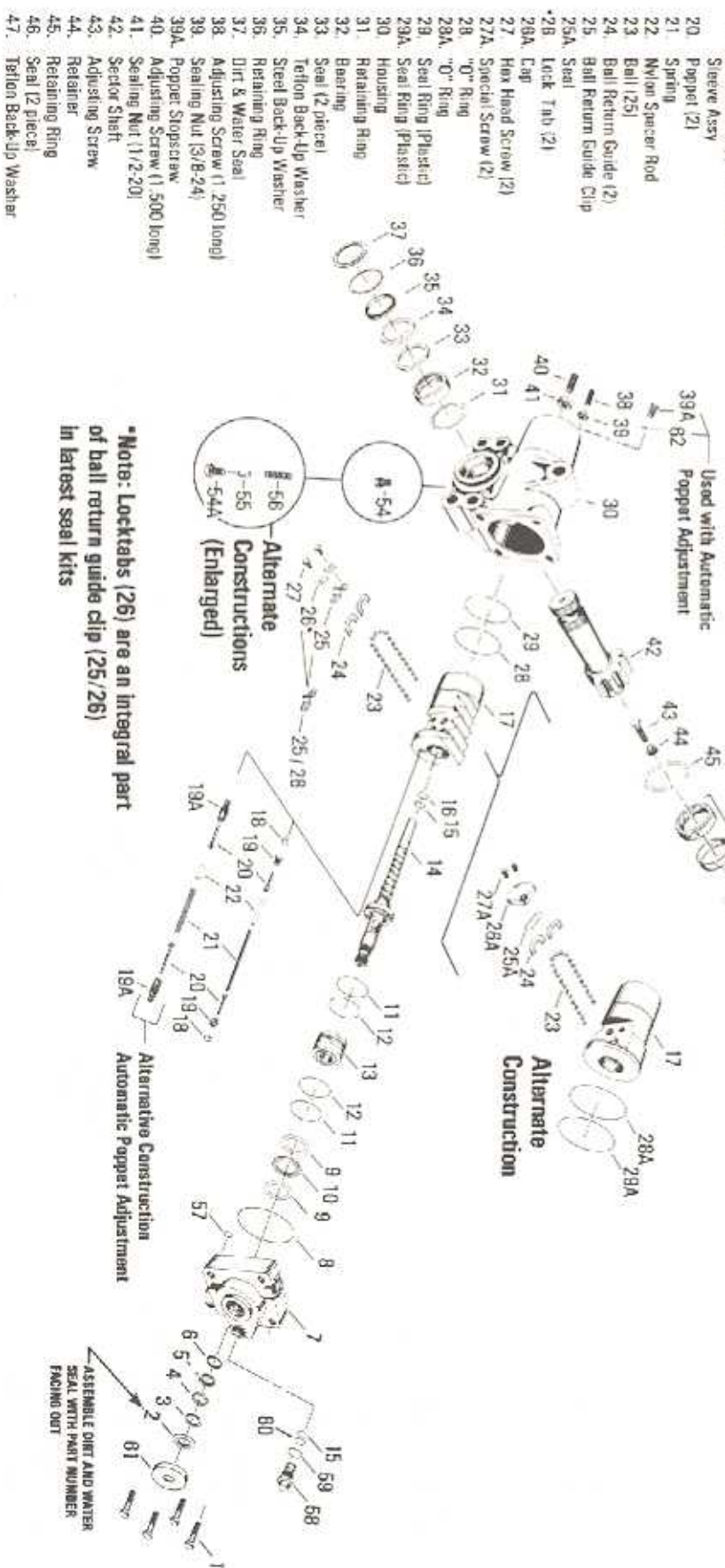


Figure 34

HF852 Exploded Assembly View – Typical

Item No. Description

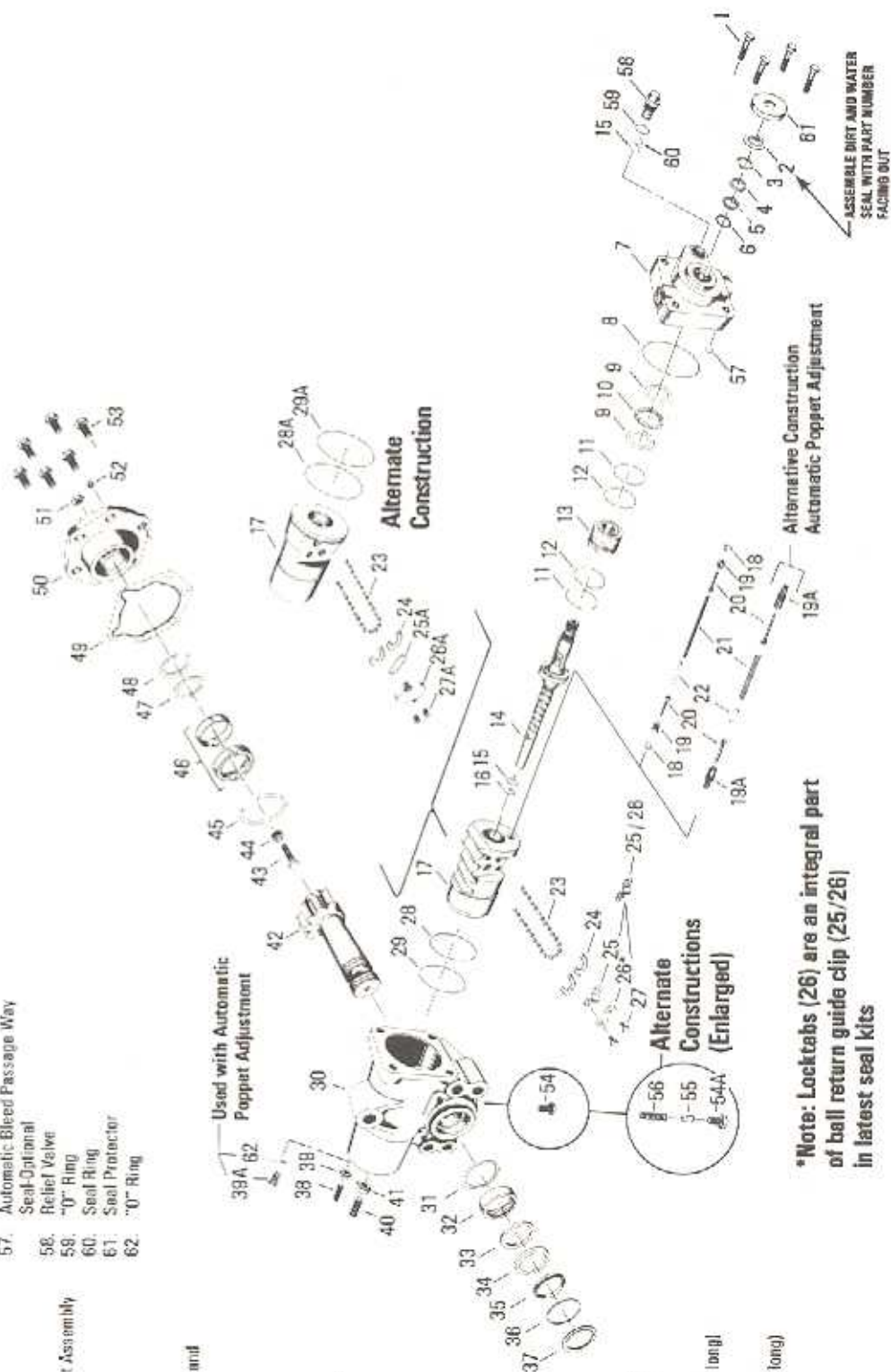
1. Hexagon Head Bolt (4) (7/16 x 2.00)
2. Dirt & Water Seal
3. Retaining Ring
4. Steel Back-Up Washer
5. Seal Cup
6. "O" Ring
7. Valve Housing
8. "O" Ring
9. Thrust Washer (2)
10. Thrust Bearing
11. Teflon Seal Ring (2)
12. "O" Ring (2)
13. Valve Sleeve
14. Worm Shaft/ Input Shaft Assembly
15. "O" Ring (2)
16. Seal Ring (Plastic)
17. Rack Piston
18. Retaining Ring (2)
19. Poppet Seat (2)
- 19A. Automatic Poppet Seat and Sleeve Assy
20. Poppet (2)
21. Spring
22. Nylon Spacer Rod
23. Ball (25)
24. Ball Return Guide (2)
25. Ball Return Guide Clip
- 25A. Seal
26. Lock Tab (2)
- 26A. Cap
27. Hex Head Screw (2)
- 27A. Special Screw (2)
28. "O" Ring
- 28A. "O" Ring
29. Seal Ring (Plastic)
- 29A. Seal Ring (Plastic)
30. Housing
31. Retaining Ring
32. Bearing
33. Seal (2 piece)
34. Teflon Back-Up Washer
35. Steel Back-Up Washer
36. Retaining Ring
37. Dirt & Water Seal
38. Adjusting Screw (1) (250 long)
39. Sealing Nut (3/8-24)
- 39A. Poppet Stop Screw
40. Adjusting Screw (1) (500 long)
41. Sealing Nut (1/2-20)
42. Sector Shaft
43. Adjusting Screw
44. Retainer
45. Retaining Ring
46. Seal (2 piece)
47. Teflon Back-Up Washer
48. Steel Back-Up Washer
49. Side Cover Gasket
50. Side Cover Assy
51. Jam Nut (1/2-20)
52. Vent Plug
53. Special Bolt (6) (8/16 – 3 x 1 1/2)
54. Bleed Screw
- 54A. Automatic Bleed Screw
55. Special Pin
56. Spring
57. Automatic Bleed Passage Way
58. Seal (Optional)
59. Relief Valve
60. "O" Ring
61. Seal Protector
62. "O" Ring



***Note: Locktabs (26) are an integral part of ball return guide clip (25/26) in latest seal kits**

HF552 Exploded Assembly View — Typical (Identical to 193)

- Item No. Description
1. Hexagon Head Bolt (4) (7/16 x 2.00)
 2. Dirt & Water Seal
 3. Retaining Ring
 4. Steel Back-Up Washer
 5. Seal Cup
 6. "O" Ring
 7. Valve Housing
 8. "O" Ring
 9. Thrust Washer (2)
 10. Thrust Bearing
 11. Teflon Seal Ring (2)
 12. "O" Ring (2)
 13. Valve Sleeve
 14. Worm Shaft/Input Shaft Assembly
 15. "O" Ring (2)
 16. Seal Ring (Plastic)
 17. Rock Piston
 18. Retaining Ring (2)
 19. Poppet Seat (2)
 - 19A. Automatic Poppet Seat and Sleeve Assy
 20. Poppet (2)
 21. Spring
 22. Nylon Spacer Rod
 23. Ball (25)
 24. Ball Return Guide (2)
 25. Ball Return Guide Clip
 - 25A. Seal
 - 25B. Lock Tab (2)
 - 26A. Cap
 27. Hex Head Screw (2)
 - 27A. Special Screw (2)
 28. "O" Ring
 - 28A. "O" Ring
 29. Seal Ring (Plastic)
 - 29A. Seal Ring (Plastic)
 30. Housing
 31. Retaining Ring
 32. Bearing
 33. Seal (2 piece)
 34. Teflon Back-Up Washer
 35. Steel Back-Up Washer
 36. Retaining Ring
 37. Dirt & Water Seal
 38. Adjusting Screw (1.250 long)
 39. Sealing Nut (3/8-24)
 - 39A. Poppet Shop screw
 40. Adjusting Screw (1.500 long)
 41. Sealing Nut (1/2-20)
 42. Sector Shaft
 43. Adjusting Screw
 44. Retainer
 45. Retaining Ring
 46. Seal (2 piece)
 47. Teflon Back-Up Washer
 48. Steel Back-Up Washer
 49. Side Cover Gasket
 50. Side Cover Assy
 51. Jam Nut (1/2-20)
 52. Vent Plug
 53. Special Bolt (6) (9/16-8 x 1")
 54. Bleed Screw
 - 54A. Automatic Bleed Screw
 55. Special Pin
 56. Spring
 57. Automatic Bleed Passage Way Seal-Optional
 58. Relief Valve
 59. "O" Ring
 60. Seal Ring
 61. Seal Protector
 62. "O" Ring



*Note: Locktabs (26) are an integral part of ball return guide clip (25/26) in latest seal kits

Alternate Construction Automatic Poppet Adjustment

Alternate Construction

Alternate Constructions (Enlarged)

ASSEMBLE DIRT AND WATER SEAL WITH PART NUMBER FACING OUT

5 Cross-shaft or Sector-shaft Adjustment

(With vehicle engine off)

locate
adjusting nut

- 5.1 If the sector-shaft adjusting screw jam nut (51), located on the side cover, is not accessible, the steering gear must be removed prior to adjustment.

remove the
drag link

- 5.2 If the sector shaft adjusting screw (43) is accessible, remove the drag link from the pitman arm.

CAUTION

CAUTION: This adjustment must be performed with the sector shaft on its center of travel.

NOTE

NOTE: Because of pitman arm or internal stops or poppet adjustment the "center of travel" for this adjustment may not be the center of sector shaft or handwheel rotation.

center the
sector shaft

- 5.3 To position the sector shaft (42) on center of travel for this adjustment rotate steering wheel (worm shaft/input shaft) until the timing mark across the end of the sector shaft is perpendicular to the worm shaft/input shaft (14). See Figure 35 page 20.

check
for lash

- 5.4 With the sector shaft (42) in the center position, grasp the pitman arm and gently try to move this arm back and forth in the direction of travel. Finger-tip force is adequate to detect lash of a loose sector shaft. There must be no movement of the input shaft or sector shaft. If no lash is detected, do not adjust.

position adjusting
screw

- 5.5 If lash is detected, loosen jam nut (51) with a 3/4 inch socket and move the adjusting screw (43) clockwise until the sector shaft and rack piston (17) are in contact. (Use no more than 10 ft. lbs. (14 N m) of torque). Then, turn the adjusting screw counterclockwise one turn.

check for lash

- 5.6 At this point, there should be lash at the pitman arm.

eliminate
lash

- 5.7 To adjust, slowly turn the adjusting screw (43) clockwise until no lash is felt at the pitman arm. Hold the adjusting screw in place, and tighten the jam nut (51). Final torque 40-45 ft. lbs. (54-61 N m).

recheck
for lash

- 5.8 Recheck the pitman arm for lash. Turn the steering wheel 1/4 turn each side of center. No lash should be felt. If lash exists, repeat adjustments 5.3-5.8.

connect
drag link

- 5.9 Re-connect drag link to pitman arm.

Torque Chart

Part Name	Item Number	Torque
Valve housing bolts (4)	1	45-55 ft. lbs. (61-75 N m)
Valve housing bolts (4)	1 if lubricated	33-40 ft. lbs. (45-54 N m)
Poppet adjusting screw sealing nut	39	12-18 ft. lbs. (16-24 N m)
Poppet stop screw	39A	15-25 ft. lbs. (20-34 N m)
Relief valve	58	25-35 ft. lbs. (34-48 N m)
Manual bleed screw	54	27-33 in. lbs. (3.1-3.7 N m)
Automatic bleed screw	54A	16-20 ft. lbs. (22-27 N m)
Auxiliary cylinder fitting	—	25-35 ft. lbs. (34-48 N m)
Poppet seat	19	20-25 ft. lbs. (27-34 N m)
Poppet seat and sleeve ass'y	19A	9-11 ft. lbs. (12-15 N m)
Worm shaft adjusting screw sealing nut	41	40-50 ft. lbs. (54-68 N m)
Worm shaft preload adjusting screw	40	25-30 in. lbs. (2.8-3.4 N m)
Hex head screws (2)	27	14-22 ft. lbs. (19-30 N m)
Allen head or Torx head screws (2)	27A	14-22 ft. lbs. (19-30 N m)
Sector shaft adjusting screw jam nut	51	40-45 ft. lbs. (54-61 N m)
Special bolts (4)	53	150-170 ft. lbs. (203-230 N m)
Special bolts (4)	53 if lubricated	108-128 ft. lbs. (146-174 N m)
Pitman arm clamp bolt	Lubricated or Plated	160-180 ft. lbs. (217-244 N m)
Pitman arm clamp bolt	Dry or Unplated	220-240 ft. lbs. (298-325 N m)
Universal joint bolts — torque to vehicle manufacturer's specifications		

All torques specified in this manual are for dry/unplated parts unless otherwise specified.

Tools and Materials Required for Servicing

Service manual	Retaining ring pliers
Masking tape	Breaker bar
Grease — **Mobil Temp 1 or 2 or equivalent	Ratchet
Wheel bearing grease	Sockets: 1/2, 5/8, 13/16, 7/8, 15/16,
Adjustable wrench	1 inch
Pocket knife	Allen sockets: 1/4, 5/32, 3/16 inch
Torque wrench — in. lbs. (N m)	12-point sockets: 11/16 and 3/4 inch
Torque wrench — ft. lbs. (N m)	Torx sockets: T-30, E 10
Soft punch	Pitman arm puller
Rubber mallet	Screw driver
Allen wrench set	Slot type screwdriver socket
Vise	Chisel
	Box end wrenches: 11/16, 3/4, 7/8 inch

Special Tools*

Complete Tool Kit	J26838	Seal Installation Tool	J26815
Seal Installation Tool	J26650-01	Seal Driving Tool	J26653
Seal Compression Tool	J26649	Seal Driving Tool	J26654
Seal Installation Tool	J26647	Relief Valve Plug	J29059
Seal Compression Tool	J26648	Bearing Mandrel	J26651
Poppet Seat Tool	J36452 (not included in kit J26838)		

*Special Tools Available From: Kent-Moore Tool Division
29784 Little Mack
Roseville, MI 48066
Phone: 313-774 9500
TELEX: 23-5377

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Disassembly

Preparation

- THOROUGHLY CLEAN OFF ALL OUTSIDE DIRT, ESPECIALLY FROM AROUND FITTINGS AND HOSE CONNECTIONS, BEFORE YOU REMOVE THE GEAR.
- Drain the steering gear assembly.
- Remove input and output shaft connections per 1.1 and 2.1, Page 11 and 14.
- If the steering gear has automatically set poppet adjustment adhere to all cautions and procedures pertaining to these special units. Refer to alternate construction automatic poppet adjuster seat and sleeve assembly (19A) and poppet stop screw (39A) on pages 19B and 19C to make this determination.

CAUTION: Do not allow the input shaft on a steering gear with the automatic poppet adjustment feature to rotate more than 1.5 revolutions from "straight ahead position" when the output shaft is disconnected from the vehicle steering linkage as this could disrupt the poppet setting achieved at initial installation.

- Remove the supply and return lines from the gear, and immediately plug all port holes and fluid lines.

WARNING: THIS STEERING GEAR WEIGHS APPROXIMATELY 60 POUNDS 27.2 KG DRY. EXERCISE CAUTION WHEN YOU REMOVE, LIFT, OR CARRY IT. DO NOT POUND THE UNIVERSAL JOINT OR INPUT SHAFT COUPLING ON OR OFF THE INPUT SHAFT. INTERNAL DAMAGE TO THE STEERING GEAR CAN RESULT.

- Remove the steering gear from the vehicle and take it to a clean surface (a piece of wrapping paper makes an excellent disposable top).
- Clean and dry the gear before you start to disassemble it.
- As you disassemble the gear, clean all parts in clean, petroleum based solvent, and blow them dry only.

WARNING: SINCE THEY ARE FLAMMABLE, BE EXTREMELY CAREFUL WHEN USING ANY SOLVENT. EVEN A SMALL EXPLOSION OR FIRE COULD CAUSE INJURY OR DEATH.

WARNING: WEAR EYE PROTECTION AND BE SURE TO COMPLY WITH OSHA OR OTHER MAXIMUM AIR PRESSURE REQUIREMENTS.

CAUTION: Never steam clean or high-pressure wash hydraulic steering components. Do not force or abuse closely fitted parts.

- Keep each part separate to avoid nicks and burrs.
- Discard all seals, O-rings, and gaskets removed from the gear. Replace them with new parts only.

Disassembly

position gear and sector shaft

1. Position the gear in a vise with the gear's worm shaft/input shaft (14) in a horizontal direction. Rotate the worm shaft/input shaft with an 11/16 inch or 3/4 inch 12 point socket or box end wrench to position the timing mark located on the end of the sector shaft (42) to a vertical direction (FIG. 35).



Figure 35



Figure 36



Figure 37

CAUTION

CAUTION: Clamp only against housing mounting bosses or attach a plate to the mounting bosses for this purpose. Do not clamp against the body of housing.

remove dirt and water seal

2. Remove and discard the dirt and water seal (37) from the housing (30) trunnion (FIG. 36).

clean sector shaft and loosen jam nut

3. Remove any paint or corrosion from the non serrated area of the sector shaft (42) as in 1.3, Page 11, and loosen the sector shaft adjusting screw jam nut (51) (FIG. 37). 3/4 inch socket required.

tape sector shaft

4. Tape the serrations and bolt groove of the sector shaft (42) with one layer of masking tape to prevent loose bearing rolls from "hanging up" the sector shaft during it's removal (FIG. 38). The tape should not extend on to the sector shaft bearing diameter.

remove side cover bolts

5. Prepare for fluid to drain, and remove the six special bolts (53) from the side cover (50) with a 13/16 inch socket (FIG. 39).

NOTE

NOTE: These bolts are special because they are equipped with either a ring or washer design on the underside of the head (FIG. 40). If you replace one or more bolts, you must use bolts of either design and of the SAME SPECIAL TYPE AND LENGTH AS THOSE YOU REMOVED. Do not use a substitute. You can get these bolts through your OEM parts distributor.

begin to remove side cover & sector shaft

6. Begin to slowly remove the side cover (50) and sector shaft (42) as an assembly (FIG. 41). Stop removal when the bearing rolls in the housing bearing (32) are half exposed. Coat the bearing rolls with grease. As a means of starting the removal of the side cover and sector shaft assembly, you may use a soft hammer or wooden handle (FIG. 42).

NOTE

NOTE: When the bearing rolls are half exposed and it is evident that the unit has a caged bearing (rolls retained), the following caution note does not apply.

CAUTION

CAUTION: Take care to remove this assembly slowly, or it may come out too quickly for you to retain the loose bearing rolls in the housing bearing race. Follow the shaft end with the bearing tool (J26651) to retain the rolls, or when the rolls are half exposed, be sure to coat them with grease to retain them in the housing bearing (FIG. 42). If one or more of the rolls is lost, you must replace the entire bearing.

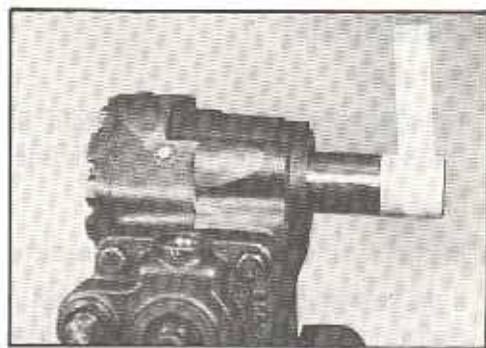


Figure 38



Figure 39

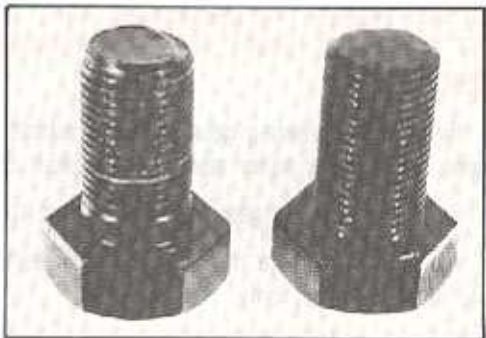


Figure 40



Figure 41



Figure 42

remove side cover and sector shaft

7. Finish removing the side cover (50) and sector shaft (42) as an assembly. Remove side cover gasket (49) and discard.



Figure 43

remove retaining ring

8. Remove retaining ring (36) from the housing (30), using a screw driver or knife to pry the end loose (FIG. 43).

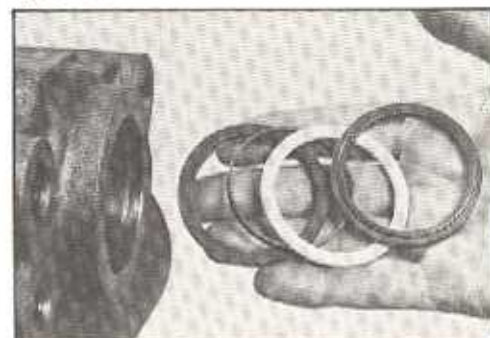


Figure 44

remove backup washers and seal

9. Remove steel backup washer (35), Teflon backup washer (34) and two-piece seal (33). Discard washer (34) and seal (33). (FIG. 44).

remove bearing rolls

10. If the housing bearing has loose rolls, remove the 39 bearing rolls from the bearing (32) race and put them aside as a set for cleaning, inspecting and reassembly.



Figure 45

remove jam nut

11. Remove the sector shaft adjusting screw jam nut (51) (FIG. 45).

remove sector shaft from side cover

12. Screw the sector shaft adjusting screw (43) clockwise through the side cover (50) (FIG. 46). Place the side cover exterior side down and lift the sector shaft out vertically (FIG. 47).

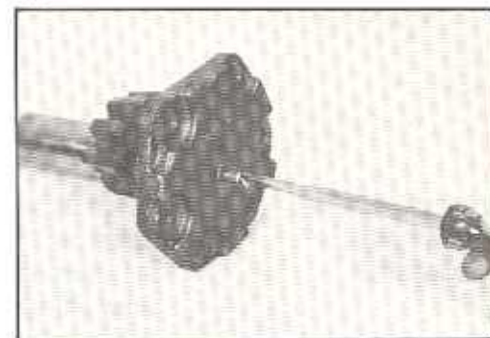


Figure 46

NOTE

NOTE: If the side cover bearing assembly has uncaged (loose) rolls, the vertical position will allow the side cover bearing rolls to fall into the side cover, where you may easily collect them. Immediately gather all of the side cover bearing rolls and count them. The bearing will have 39 rolls.

CAUTION

CAUTION: Take care not to lose any rolls during disassembly and assembly, or you will have to replace the complete side cover assembly.



Figure 47

WARNING

WARNING: IF THE BEARING IS THE UNCAGED (LOOSE) ROLL TYPE, DO NOT MIX THE ROLLS FROM THE SIDE COVER WITH THE ROLLS FROM THE HOUSING BEARING. THE BEARING RACE AND ROLLS ARE A MATCHED SET. INTERCHANGING THE ROLLS COULD RESULT IN PREMATURE BEARING OR SEAL FAILURE, WHICH COULD CAUSE A LOSS OF POWER STEERING.

remove retainer
and adjusting
screw

13. Only if replacement of the retainer and/or adjusting screw is required (see inspection procedure B page 32), unstake the retainer (44), using a suitable chisel and turn it out of the sector shaft (42) pocket and remove adjusting screw (43). Discard the retainer (FIG. 48).

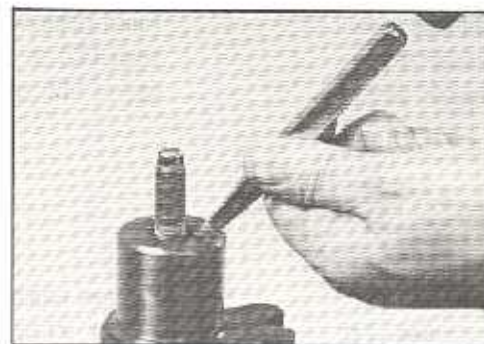


Figure 48

remove side
cover seal
package

14. Remove the side cover retaining ring (45) (FIG. 49), the side cover seal (2 piece) (46), the Teflon backup washer (47), and the steel backup washer (48) from the side cover (50) (FIG. 50). Discard the two-piece seal and the Teflon backup washer. Remove the vent plug (52) and discard it.



Figure 49

remove adjusting
screws and
sealing nuts

15. Loosen the worm shaft preload adjusting screw sealing nut (41) with a 7/8 inch box end wrench, and loosen the worm shaft preload adjusting screw (40) about two turns with a 1/4 inch Allen socket or screw driver (FIG. 51). If your gear is equipped with poppets, loosen the poppet adjusting sealing nut (39) and the poppet adjusting screw (38) about two turns. 11/16 inch box end and 1/4 inch Allen wrench required.



Figure 50

NOTE

NOTE: The worm shaft adjusting screw and sealing nut and poppet adjusting screw and sealing nut or the automatic poppet stop screw (plug) assembly (39A)/(62) do not have to be removed from housing (30) unless apparent fluid leaks indicate the sealing nuts or o-ring (62) be replaced.

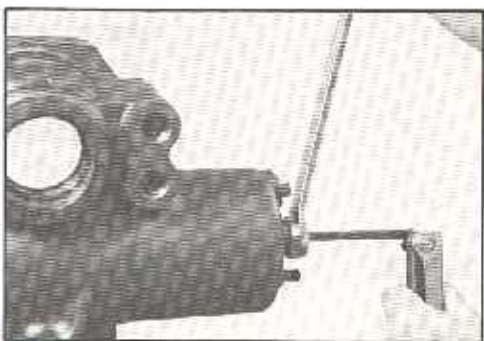


Figure 51

remove relief valve, if equipped

16. Remove the relief valve (58), if equipped, from the valve housing (7) (FIG. 52) using a 1 inch hex. socket or box end wrench.

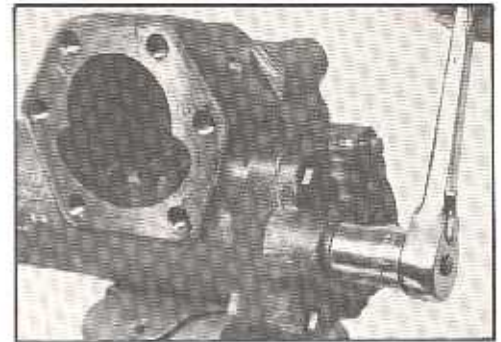


Figure 52

remove relief valve seal pack

17. Remove and discard the two relief valve O rings (59 and 151) and the Teflon seal ring (60) from the relief valve (58) (FIG. 53).

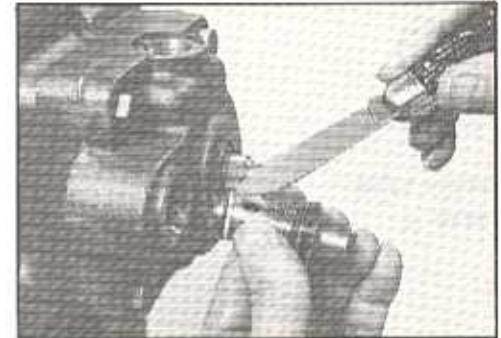


Figure 53

remove seal protector and clean input shaft

18. Remove seal protector (61) from input shaft (14). Clean any paint or foreign matter from the nonserrated area of the input shaft with a fine grade of emery paper, as in 2.1, page 14. Discard seal protector.

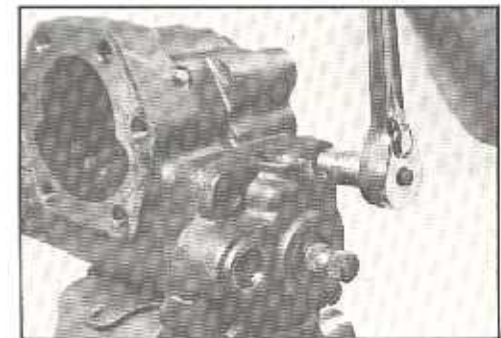


Figure 54

NOTE

NOTE: It is recommended that a line be scribed across the edge of valve housing (7) and gear housing (30) before disassembly of valve housing for correct positioning at reassembly.

remove valve housing bolts and valve housing

19. Remove the four valve housing bolts (1) with a 5/8 inch socket (FIG. 54). Prepare for some fluid to drain, and remove the valve housing (7) (FIG. 55).

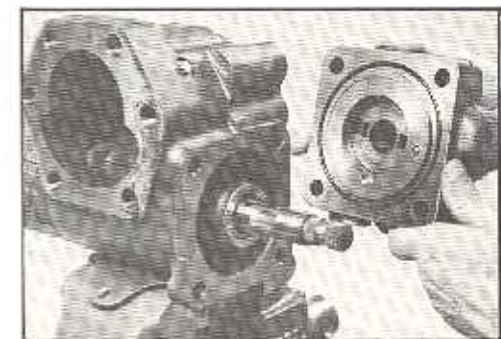


Figure 55

NOTE

NOTE: The valve sleeve (13) will probably remain in the valve housing.

WARNING

WARNING: DO NOT DISASSEMBLE THE WORM SHAFT/INPUT SHAFT ASSEMBLY (14), WHICH INCLUDES THE WORM SHAFT, INPUT SHAFT, TORSION BAR, TORSION BAR PINS, DRIVE RING AND DRIVE RING RETAINER, AND INSERT. DO NOT UNBEND THE DRIVE RING RETAINER TANGS THAT HOLD THE DRIVE RING IN PLACE (FIG. 56). DOING EITHER WILL ALTER THE VALVE TIMING, WHICH COULD CAUSE THE VEHICLE TO PULL TO ONE SIDE OR THE OTHER.

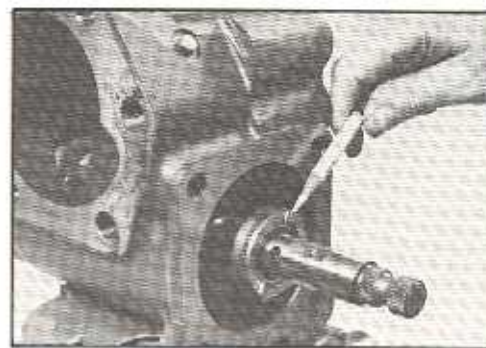


Figure 56



Figure 57



Figure 58



Figure 59

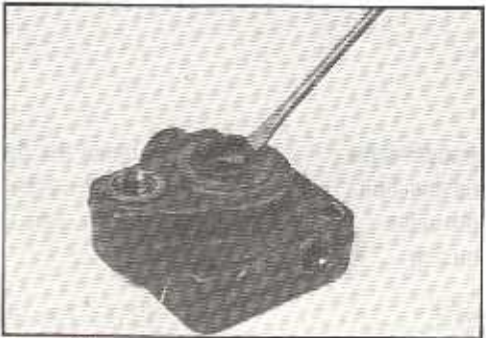


Figure 60

remove valve sleeve

20. Remove the valve sleeve (13) from the valve housing (7) (FIG. 57).

remove thrust washers and bearing

21. Remove the first thrust washer (9), the thrust bearing (10), and the second thrust washer (9) from the valve housing (7) (FIG. 58).

NOTE

NOTE: The thrust washer (9) may stay on the end of the valve sleeve. If so, remove it from the sleeve.

remove seal rings

22. Remove and discard the two Teflon seal rings (11) from the valve sleeve (13) (FIG. 59).

remove O-rings

23. Remove and discard the two backup O-rings (12) from the grooves in the valve sleeve (13).

remove O-ring

24. Remove and discard seal ring (8) from valve housing (7) and the automatic bleed passage way seal (57) if included.

remove dirt and water seal

25. Remove and discard the dirt and water seal (2) (FIG. 60).

remove
retaining ring

26. Remove the retaining ring (3) (FIG. 61).



Figure 61

remove valve
housing seal
package

27. Remove the steel backup washer (4), the input shaft seal cup (5), and the input shaft O-ring (6) from the valve housing (7) (FIG. 62). Discard the seal and O-ring.



Figure 62

remove rack
piston and
worm shaft

28. Remove the rack piston (17) and worm shaft/ input shaft assembly (14) from the gear housing (30) as an assembly (FIG. 63).

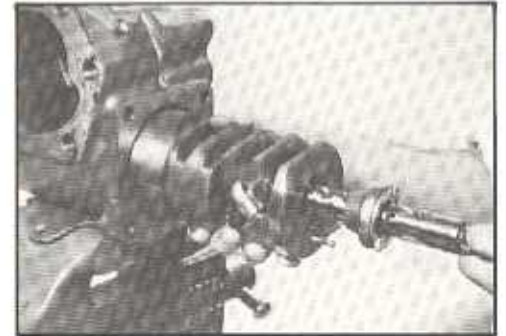


Figure 63

NOTE

NOTE: The worm shaft part of the assembly will be inside the rack piston, with the input shaft part of the worm protruding from the rack. Take care when you remove this assembly from the housing to prevent the Teflon rack piston seal ring (29) or (29A), from getting caught in the sector shaft cavity.

Set the rack piston and worm shaft/ input shaft assembly on a clean rag to keep the piston from rolling.

NOTE

NOTE: The HFB52 gear will have one of two rack piston designs.

remove ball
return guide
clip, if equipped

29. For rack pistons with the ball return guide clip (25), bend the tangs down that are on the clip or on the two lock tabs (26) (FIG. 64). Remove the two hex head bolts (27), tabs and clip. Discard lock tabs (FIG. 65). 1/2 inch hex socket required.

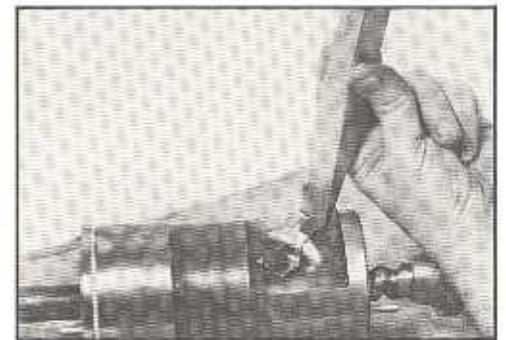


Figure 64

NOTE

NOTE: The current HFB52 units and seal kits will utilize a ball return guide clip (25/26) with the two lock tabs integral to it.

NOTE

NOTE: If the seal kit being used includes a ball return guide clip (25/26) with integral lock tabs, discard the ball return guide clip removed from the unit.



Figure 65

remove ball
return guide
cap, if equipped

CAUTION

30. For a rack piston with the ball return guide cap (26A) instead of the clip, remove the two special screws (27A) which will require either a 5/32 inch allen wrench or a T-30 torx wrench (FIG. 66). Remove the ball return guide cap and the ball return cap seal (25A) (FIG. 67). Discard screws and cap seal.

CAUTION: If the rack piston assembly has the automatic poppet adjuster seat and sleeve assembly (19A) handle the rack piston assembly with care so that the set position of poppet adjuster is not disturbed.

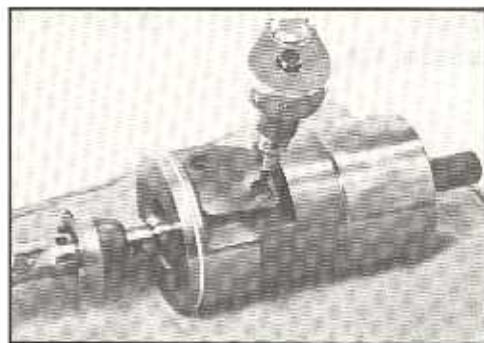


Figure 66



Figure 67

remove guides
and balls

31. Remove the halves of the ball return guide (24) (FIG. 68). Next, remove the 25 steel balls (23) from the rack piston (17) by rotating the worm shaft/input shaft (14) until the balls fall out (FIG. 69).

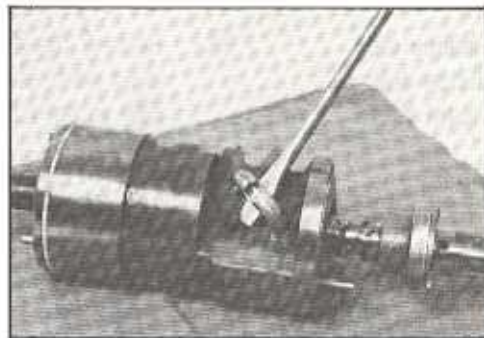


Figure 68

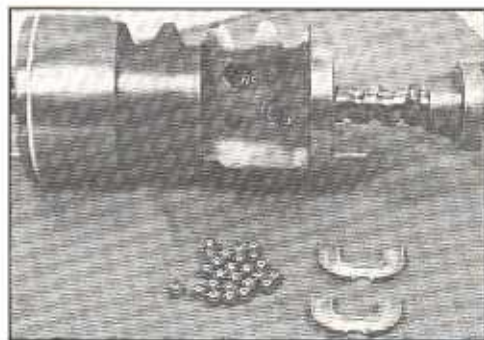


Figure 69

NOTE

NOTE: The ball return guide is closely fitted with the rack piston, and you may have to remove the halves by carefully inserting a screw driver between the rack and the guide. See composite picture of both assembly types in FIG. 70.

CAUTION

CAUTION: The 25 steel balls are a matched set. Take care not to lose any of them. If you lose any of the balls, you must replace them with a complete, new set.

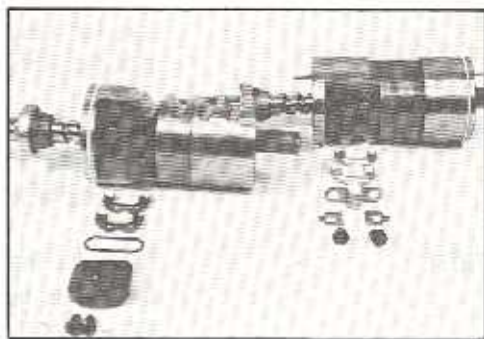


Figure 70

WARNING

WARNING: INCORRECT MATCHING OF BALLS, WORMSCREW AND RACK PISTON CAN RESULT IN LOSS OF STEERING, WHICH COULD RESULT IN AN ACCIDENT.

**remove worm
shaft/input
shaft**

32. Remove the worm shaft/input shaft assembly (14) from the rack piston (17) (FIG. 71)

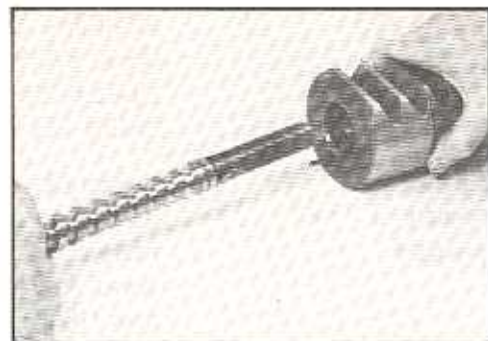


Figure 71

**remove seal and
O-ring**

33. Remove and discard the teflon rack piston seal ring (29 or 29A) and backup O-ring (28 or 28A) (FIG. 72).



Figure 72

**remove worm
shaft seal and
ring**

34. Remove and discard the teflon worm shaft seal ring (16) and O-ring (15) (FIG. 73).

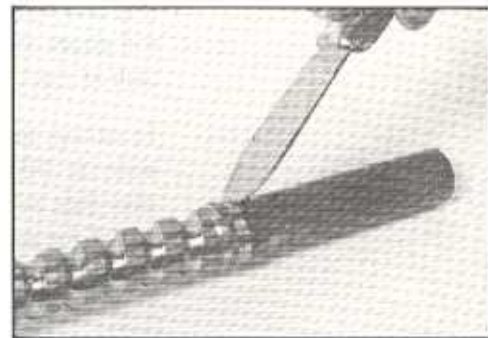


Figure 73

**remove bleed
screw**

35. Your gear may be equipped with either a manual bleed screw (54) or an automatic air bleed assembly (54A) (55) (56). If your gear has the manual bleed screw, remove it from the gear housing (30) (FIG. 74). A 5/16 inch socket required. If your gear has the automatic air bleed assembly, it is usually not required that you service it. If it is necessary, however, remove the automatic bleed screw (54A) from the gear housing. Then, tilt the housing upside down so that the special pin (55) and spring (56) will fall out (FIG. 75). A 1/2 inch Hex or E-10 Torx socket required.



Figure 74



Figure 75

WARNING

WARNING: DURING STEP 36 YOU SHOULD WEAR EYE PROTECTION, AS THE SPRING LOADED POPPETS COULD EJECT, AND CAUSE EYE INJURY.

remove
poppets, if
equipped

36. If your gear is equipped with poppets, they will usually not require servicing. If it is necessary, however, position the rack piston (17) in a soft-jawed vice. Then, remove two poppet retaining rings (18) (FIG. 76), two poppet seats (19) (FIG. 77), two poppets (20), the nylon spacer rod (22), and the poppet spring (21) (FIG. 78).

If your gear is equipped with automatic poppet adjustor seat and sleeve assemblies (19A) do not remove them from the rack piston (17) unless they are damaged, the automatically set poppet adjustment has been disturbed or the steering gear is to be installed in a different vehicle. This would require removal and replacing or resetting of the poppet adjustor and sleeve assemblies for automatic positioning after the next installation.

It is only necessary to remove one adjuster seat and sleeve assembly from the rack piston to reset both of them for automatic adjustment.

To remove the poppet adjustor seat and sleeve assembly (19A) use special tool J36452. This tool must slide over the smaller diameter adjustor seat end of the assembly and engage the slot in the threaded adjustor sleeve of the assembly to turn it out of the rack piston (FIG. 78A).



Figure 76

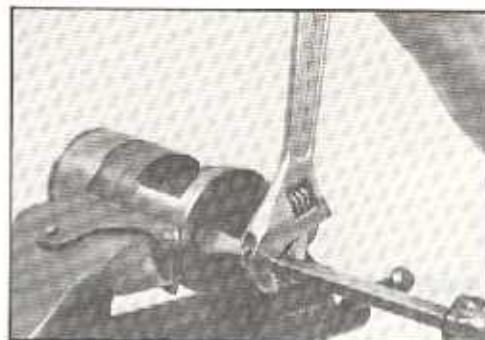


Figure 77

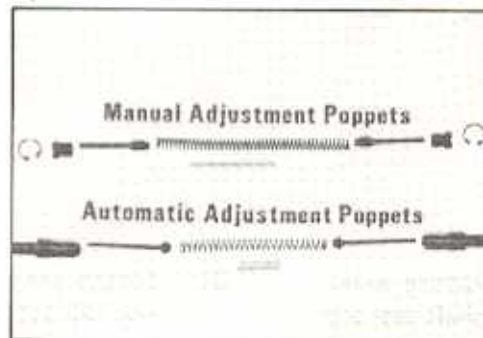


Figure 78

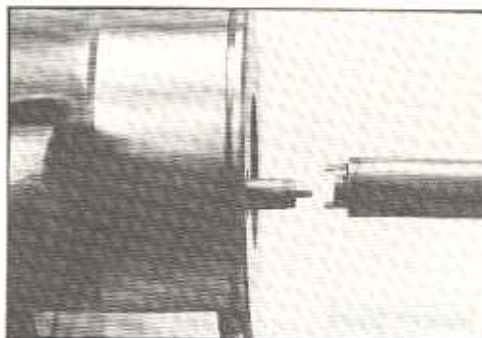


Figure 78A



Figure 79

CAUTION

CAUTION: Do not use the oil slot in the end of the smaller diameter adjustor seat to turn the adjustor seat & sleeve assembly out or into the rack piston as damage to the adjustor seat could result.

remove housing
bearing, if
necessary

37. The housing bearing assembly (32) or race should only be removed if you determine that the bearing must be replaced after following inspection procedures 4, 5 and 6 on page 31. Remove the bearing in the following manner: Remove retaining ring (31). Use bearing mandrel (special tool) J26651 to apply pressure from the trunnion side opening and press the bearing out through the side cover opening (FIG. 79). Maintain a good, square contact between the housing and press base to avoid damaging the housing bearing bore. Discard bearing.

CAUTION

CAUTION: If the bearing is cocked while you press it out, it will burnish the bore, causing it to become oversized. You will then have to replace the gear housing.

This completes disassembly of the HFB52 steering gear.

Inspection

- Check to make sure that all sealing surfaces and seal cavities are free from nicks and corrosion. If any part is nicked or corroded where sealing occurs, you must replace the part to insure proper sealing.
- Wash all parts in clean petroleum-based solvent. Blow them dry only.

WARNING

WARNING: SINCE THEY ARE FLAMMABLE, BE EXTREMELY CAREFUL WHEN USING ANY SOLVENT. EVEN A SMALL EXPLOSION OR FIRE COULD CAUSE INJURY OR DEATH.

WARNING

WARNING: WEAR EYE PROTECTION AND BE SURE TO COMPLY WITH OSHA OR OTHER MAXIMUM AIR PRESSURE REQUIREMENTS.

inspect rack piston teeth

1. Inspect the rack piston (17) teeth for cracks and wear. If you can detect a step by running your fingernail horizontally across the teeth surface, you must replace both the rack piston and sector shaft (42) and set of 25 balls (23) (FIG. 80).

inspect rack piston internal grooves

2. Inspect the rack piston internal ball-track grooves for brinelling (dents) or spalling (flaking) (FIG. 81). If either condition exists, you must replace all of the following parts: the rack piston (17), the worm shaft/input shaft assembly (14), the valve sleeve (13) and the set of 25 balls.

inspect worm shaft

3. Inspect the worm shaft/input shaft assembly (14) ball track grooves for brinelling or spalling (FIG. 82). If either condition exists, you must replace all of the following parts: the worm shaft/input shaft assembly (14), the rack piston (17), the valve sleeve (13), the set of 25 balls. Visually inspect the upper shaft seal area near the input shaft serrations for nicks, and run your fingernail edge across the sealing surface to detect steps (FIG. 83). Visually inspect the sleeve (13) contact area of the worm shaft/input shaft for discoloration from excess heat. If either of these conditions exist you must replace the worm shaft/input shaft assembly (14) and valve sleeve (13) as a matched set and the set of 25 balls (23).

NOTE

NOTE: The input shaft is pinned to the worm shaft by the torsion bar pin, and the assembly is flexible and may appear slightly bent at this joint (FIG. 84). This slight bend is normal.

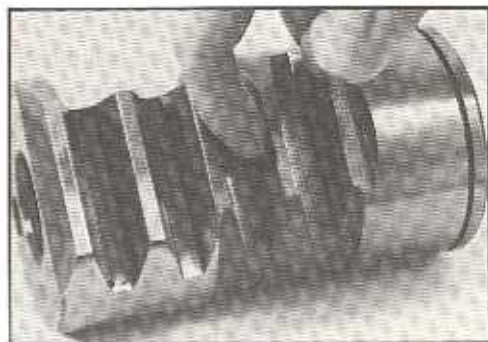


Figure 80

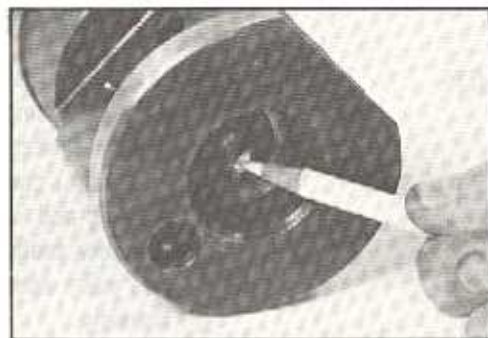


Figure 81

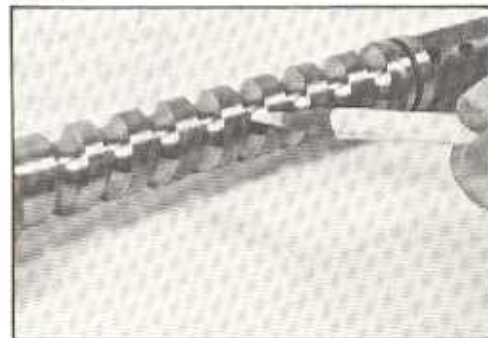


Figure 82

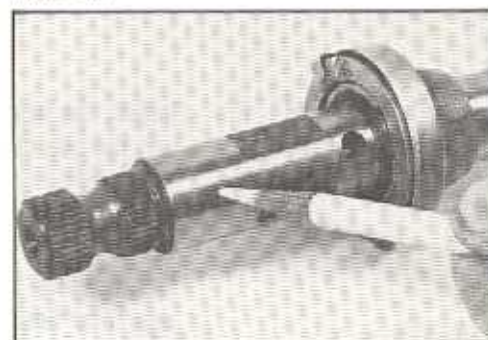


Figure 83



Figure 84

inspect housing
cylinder bore

4. Inspect the housing cylinder bore (Fig. 85), where you will probably notice normal scoring marks running lengthwise through the bore. Since this scoring is normal, you should not compare it to the scoring you might find in the cylinder bores of an internal combustion engine. Replace the housing only if you've tested it for internal leakage (as described in the troubleshooting section on page 7) and you've determined that the scoring, and not damaged seals, is responsible for the excessive internal leakage (greater than 1.5 gpm (5.7 l/min.)).



Figure 85

NOTE

NOTE: In running the internal leakage test after reassembly of the unit, make sure that internal leakage exceeding 1.0 gpm (3.8 liters/min.) can only be attributed to the housing and not to the improper assembly of the new seals in the worm shaft, rack piston, and valve assembly, before you replace the housing.

inspect housing
faces

5. Inspect the housing (30) faces for nicks that would prevent proper sealing. Replace the gear housing if these nicks are present and cannot be easily removed with a fine-toothed flat file without changing the dimensional characteristics (FIG. 86).



Figure 86

inspect housing and
side cover bearings

6. Inspect the housing roller bearing (32) (FIG. 87) and the side cover bearing race and rolls (FIG. 88) for brinelling or spalling. If either condition exists, replace the damaged housing bearing (32). For the housing bearing, follow disassembly step 37 and assembly step 2, Pages 29 and 33. If the side cover bearing is damaged, replace side cover assembly (50).



Figure 87

WARNING

WARNING: FOR BEARING TYPE WITH UNCAGED (LOOSE) ROLLS DO NOT MIX THE ROLLS FROM THE SIDE COVER BEARING WITH THE ROLLS FROM THE HOUSING BEARING. THE BEARING RACE AND ROLLERS ARE A MATCHED SET, INTERCHANGING THE ROLLS COULD RESULT IN PREMATURE BEARING OR SEAL FAILURE, WHICH COULD CAUSE A LOSS OF POWER STEERING.



Figure 88

inspect sector
shaft assembly

7. Inspect the sector shaft (42) bearing and sealing areas and sector teeth contact surfaces for brinelling or spalling (FIG. 89). Run your fingernail edge across these areas to detect steps. Inspect also for cracks. Remove any masking tape from the shaft serrations and inspect for twisted or otherwise damaged serrations. If any of these conditions exist, replace the sector shaft.

NOTE

NOTE: A service shaft assembly will have the adjusting screw (43) and retainer (44) assembled into it. The screw (43) and retainer (44) can be serviced separately if required.

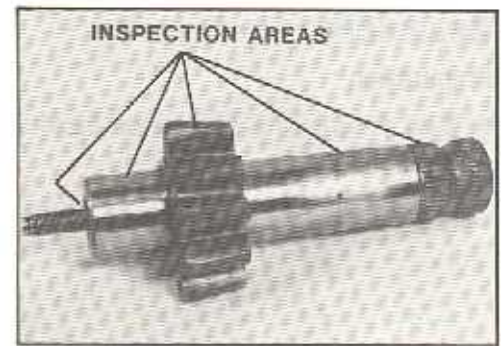


Figure 89

inspect adjusting
screw and retainer

8. Inspect the sector shaft assembly for damaged adjusting screw (43) threads. The staked retainer (44) must be locked in place, and have no cracks. The adjusting screw must rotate by hand with no perceptible end play (lash). Replace adjusting screw, if damaged. Replace the retainer, if damaged, or if the adjusting screw requires replacement or adjustment.

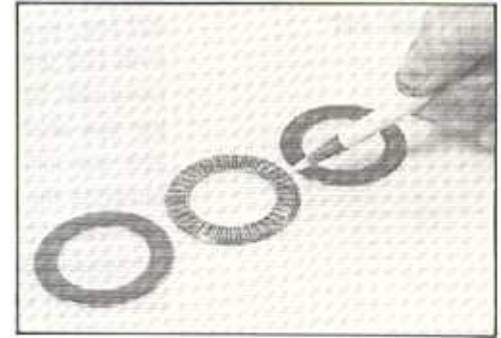


Figure 90

inspect thrust
washers and
bearing

9. Inspect the thrust bearing (10) rollers for any deterioration. Inspect the two thrust washers (9) for brinelling, spalling, or cracks (FIG. 90). Replace any part with these conditions.

This completes inspection of the HFB52 steering gear.

Assembly

Preparation

- Wash all parts in clean petroleum-based solvent. Blow them dry only.

WARNING

WARNING: SINCE THEY ARE FLAMMABLE, BE EXTREMELY CAREFUL WHEN USING ANY SOLVENT. EVEN A SMALL EXPLOSION OR FIRE COULD CAUSE INJURY OR DEATH.

WARNING

WARNING: WEAR EYE PROTECTION AND BE SURE TO COMPLY WITH OSHA OR OTHER MAXIMUM AIR PRESSURE REQUIREMENTS.

- Replace all seals, seal rings, and gaskets with new ones each time you disassemble the gear.
- Hoss Gear does provide individual seals, seal rings, and gaskets, as well as complete and partial seal kits (FIG. 91). These parts should be available through most OEM parts distributors. (Contact your local dealer for availability.)

Assembly

assemble worm
shaft seal and
ring

1. Slide compression tool J26649, small diameter end first, onto the worm end of worm shaft/input shaft (14) until it is beyond the seal ring groove. Using seal installation tool J26550-01 assemble the new worm shaft O ring (15), and then the new seal ring (16). SEE FIGURE 92, 93. Next, compress the seal ring by pulling the compression tool back over the seal ring. Allow the worm shaft/input shaft to set with compression tool in place for at least ten minutes. SEE FIGURE 94.

CAUTION

CAUTION: Be sure the compression tool is assembled correctly before assembly of the seal ring. If the tool is backwards it cannot be pulled over the new seal ring for compression or for tool removal without destroying the seal ring.

CAUTION

CAUTION: Allow for this 10 minutes to insure that the ring and seal are properly seated when you install the worm shaft into the rack piston. If you do not allow for this time, the seal may tear or be cut when you place the worm into the rack.

install housing
bearing and
retaining ring

2. If you are installing a new housing bearing or using the old housing and bearing assembly (32), apply a generous amount of clean grease to the bearing race to retain the bearing rolls. Then, place the rolls into the race, being sure that you have counted the rolls correctly and have 39. To install the new bearing assembly, press the bearing into the housing from the shaft cover side using bearing mandrel (special tool) J26651 (FIG. 95). Take care during this procedure to make

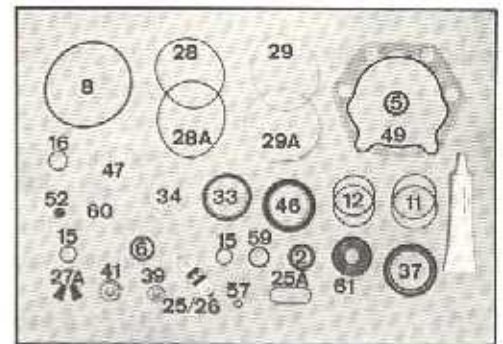


Figure 91

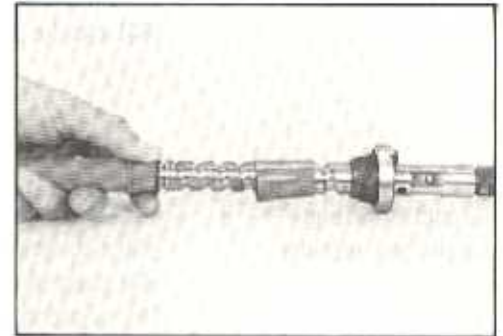


Figure 92

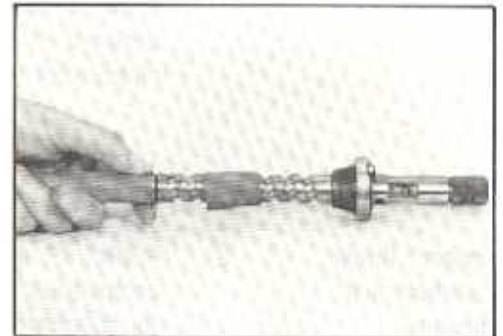


Figure 93

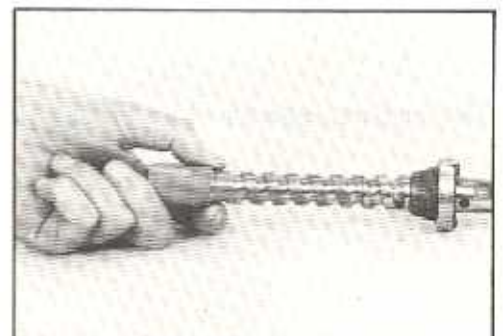


Figure 94



Figure 95

certain that the housing is square with the press base and that the bearing is not cocked. Assemble retaining ring (31).

CAUTION

CAUTION: The bearing rolls must be in place to insure proper installation of the bearing. If the rolls are improperly installed, the bearing race may collapse and fail. The flange may break, causing premature failure of the bearing. Again, do not mix the housing bearing rolls with the side cover bearing rolls. Be sure the bearing mandrel used is clean.

NOTE

NOTE: The bearing assembly (32) may be of caged (retained) roll type therefore not requiring reassembly of the rolls.

install rack piston seal and O-ring

3. Install the new rack piston backup O-ring (28) or (28A) (FIG. 96), and then the new Teflon rack piston seal ring (29) or (29A) (FIG. 97). Do not over stretch these rings as you install them. After you install them, coat them with a liberal amount of grease.

NOTE

NOTE: If a service seal kit is being utilized be sure you select the correct diameter O-ring (28) or (28A) and seal ring (29) or (29A) for the unit being serviced. O-ring (28A) and seal ring (29A) are the larger diameter.

WARNING

WARNING: DURING STEP 4, YOU SHOULD WEAR EYE PROTECTION, AS THE SPRING LOADED POPPETS COULD EJECT, AND CAUSE EYE INJURY.

NOTE

NOTE: If you are reassembling the automatic poppet adjuster seat and sleeve assemblies (19A) that were removed from the rack piston (17), they must be reset for automatic poppet adjustment before they are reassembled into the rack piston. SEE SPECIAL INSTRUCTIONS ON PAGE 50. The two threaded poppet seat holes in the rack piston, and the adjuster seat and sleeve assembly threads must be cleaned and free of old Loctite applied when previously assembled. Apply Locquic "T" primer to the threaded poppet holes in the rack piston and the threads on adjuster seat and sleeve assembly and allow to dry for ten minutes then apply Loctite RC680 to these threads. The manual adjustment poppet seats (19) or their rack piston, do not require an application of Loctite or primer.



Figure 96

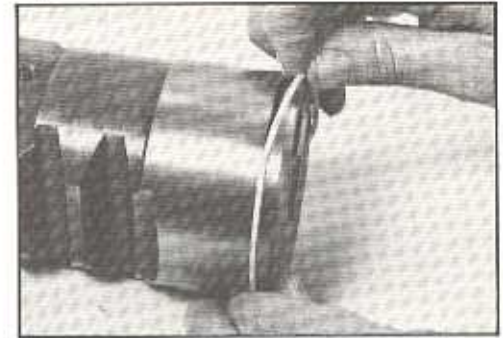


Figure 97



Figure 98



Figure 99



Figure 100

CAUTION

CAUTION: Do not allow Loctite or Locquic to get on the adjustor seat component of the adjustor seat and sleeve assembly as this would adversely affect the adjustment function of this assembly.

install poppet components

4. If poppet components were removed from rack piston (17) install them in the following order:
 - a. one poppet seat (19) or (19A), (FIG. 98) in one end of the rack piston poppet hole.From the other end of the poppet hole in the rack piston, install:
 - b. one poppet (20)
 - c. the poppet spring (21)
 - d. the nylon spacer rod (22) (FIG. 99)
 - e. the other poppet (20)
 - f. the other poppet seat (19) or (19A) (FIG. 100)Torque the poppet seats (19) to 20-25 ft. lbs. (27-34 N.m) and install both retaining rings (18). Torque the automatic poppet seats (19A) to 9-11 ft. lbs. (12-15 N.m) using special tool J36452.

install worm shaft/input shaft into rack piston

5. When the 10 minute compression time has elapsed, remove the compression tool from the worm shaft/input shaft assembly (14). Grease the sealing surface inside the rack piston (17) and install the worm shaft/input shaft assembly (14) into the rack (FIG. 101).

assemble ball return guide halves

6. Assemble the ball return guide halves (24) into the rack piston (17) (FIG. 102). Make sure they are correctly seated. Tap lightly with handle of screwdriver if necessary.

WARNING

WARNING: DO NOT SEAT GUIDES WITH A HAMMER. DAMAGE TO GUIDES CAN RESULT IN SUBSEQUENT LOCK-UP OR LOSS OF STEERING.

assemble balls

7. Assemble 25 steel balls (23) into the ball return guide through the hole provided in the top of the guide. As you drop the balls into the guide, rotate the worm shaft (14) to pull the balls down into the grooves (FIG. 103).

WARNING

WARNING: MAKE SURE THE BALL RETURN GUIDE STAYS DOWN IN PLACE AS YOU DROP THE BALLS THROUGH THE HOLE. FAILURE TO HOLD THE GUIDE DOWN MAY RESULT IN A BALL BEING TRAPPED OUTSIDE THE CLOSED LOOP. A TRAPPED BALL CAN RESULT IN A STEERING LOCKUP, WHICH COULD CAUSE AN ACCIDENT.



Figure 101



Figure 102



Figure 103



Figure 104

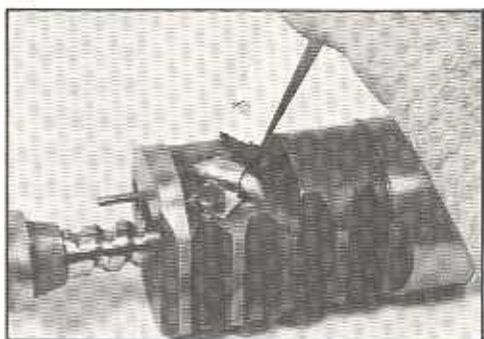


Figure 105

assemble ball
return guide clip,
if equipped

8. If your gear is equipped with the ball return guide clip (25), install it so that both bolt hole faces are in full contact with the rack piston surface. Install the two new lock tabs (26) and the two hex head screws (27). Torque the screws to 14-22 ft. lbs. (19-30 N m) with a 1/2 inch socket (FIG. 104). Finish by bending the locking tabs securely up against the screw head flats (FIG. 105).

NOTE

NOTE: The current ball return guide clip (25/26) will have integral lock tabs and be included in current service seal kits.

assemble ball
return guide cap,
if equipped

9. If your gear is equipped with the ball return guide cap (26A), instead of the clip, grease the new ball return guide cap seal (25A) and place it in the seal groove of the cap. Assemble the cap so that the seal makes full contact with the rack piston surface (FIG. 106). Install the two new Allen head or torx head screws (27A) and torque them to 14-22 ft. lbs. (19-30 N m). A 5/32 inch Allen socket or a 1-30 torx socket required.

WARNING

WARNING: ROTATE THE WORM SHAFT FROM ONE END OF TRAVEL TO THE OTHER, TO MAKE CERTAIN THAT YOU HAVE INSTALLED THE BALLS PROPERLY (FIG. 107). IF YOU CANNOT ROTATE THE WORM SHAFT, YOU WILL HAVE TO REMOVE THE BALLS AND REASSEMBLE THEM. IF YOU INSTALL A GEAR ON A TRUCK WITH THE WORM SHAFT UNABLE TO ROTATE, THE GEAR WILL NOT FUNCTION CORRECTLY. DAMAGE MAY RESULT.

install rack
piston and worm
shaft/input shaft
assembly into
housing

10. With the housing (30) held securely in a vise and positioned as it was for the disassembly procedures, (FIG. 35, Page 20) apply a generous amount of clean grease to the housing cylinder bore and to the rack piston seal ring (29) or (29A). Install the rack piston (17) and worm shaft/input shaft (14) as an assembly into the gear housing (FIG. 108).

NOTE

NOTE: To ease the later assembly of the sector shaft, rotate the rack piston and worm shaft assembly in the housing so that the rack teeth are exposed in the sector shaft cavity of the housing (FIG. 109).

CAUTION

CAUTION: A rack piston with automatic poppet adjuster and sleeve assemblies (19A) must not be allowed to bottom against the internal poppet stops in the steering gear until it is installed in the vehicle and the special adjustment procedures on page 51 are completed.

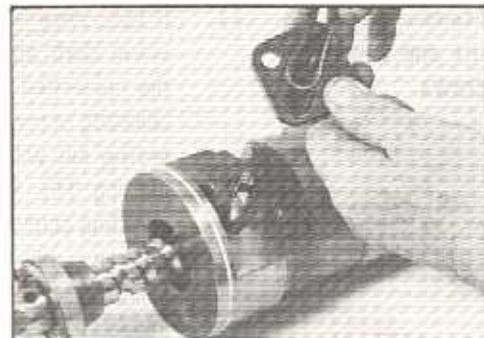


Figure 106 - alternate construction



Figure 107



Figure 108



Figure 109



Figure 110

assemble sealing
nuts and adjusting
screws

11. If they were disassembled, assemble the new worm shaft adjusting screw sealing nut (41) onto the nonslotted end of the worm shaft preload adjusting screw (40) so that the seal on the sealing nut will face the closed end of the housing (FIG. 110). Assemble poppet valve adjusting screw (38) and new sealing nut (39) in the same manner as described for parts (40) and (41), if your gear is equipped with poppets. If poppet stop screw (39A) was removed, assemble **new o-ring** (62) on screw and torque screw into the housing to 15-25 ft. lbs. (20-34 N m).



Figure 111

install adjusting
screws in housing

12. If they were disassembled, install the worm shaft preload adjusting screw (40) with sealing nut (41) and poppet adjusting screw (38) with sealing nut (39) into the closed end of the gear housing (30) a few turns (FIG. 111). Final adjustments will be made later. 1/4 inch Allen wrench socket, 7/8 inch socket and 11/16 inch socket required.



Figure 112

install valve
sleeve rings
and seals

13. Grease the two new backup O-rings (12) and the two new Teflon seal rings (11). Using seal installation tool J26647, assemble the backup O rings and then the seal rings onto the valve sleeve (113) (FIG. 112).

NOTE

NOTE: Assemble each O-ring and seal from the end closest to its groove.



Figure 113

compress rings

14. Use the compression tool J26648 to compress the Teflon seal rings (FIG. 113). Leave this compression tool on for 10 minutes.

CAUTION

CAUTION: A minimum of ten minutes with the compression tool in place is required to ensure that the seal rings are properly seated. Otherwise, the valve sleeve will be difficult to assemble into the valve housing, and the seal rings may be damaged during installation.

install valve
housing O-ring

15. Apply clean grease to the seal ring groove in valve housing (17) and install a new seal ring (8) into the groove (FIG. 114). If the unit is equipped with an automatic bleed screw, apply clean grease to a new passage way seal (57) and install it in the valve housing.



Figure 114

NOTE

NOTE: When installed, the valve housing O-ring should extend slightly above the machined surface of the valve housing.



Figure 115

install first
thrust washer

16. Apply a generous amount of clean grease to one thrust washer (9). Place the valve housing exterior side down on a flat surface and place the thrust washer into the valve housing (7), making sure to center the washer (FIG. 115).

install thrust
bearing

17. Apply a generous amount of clean grease to the thrust bearing (10). Install the bearing into the valve housing (7) and onto the first thrust washer, making sure to center the bearing on the washer (FIG. 116).

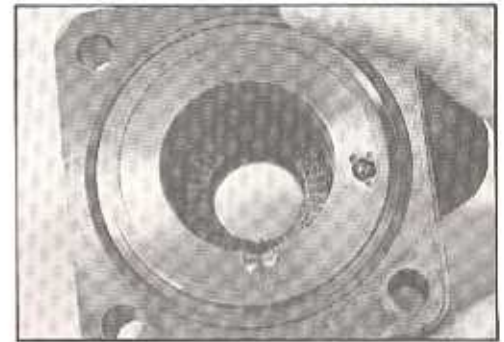


Figure 116

WARNING

WARNING: THE THRUST WASHER AND THRUST BEARING MUST BE FLAT AND CENTERED IN THE COUNTERBORE SURFACE OF THE VALVE HOUSING (FIG. 116). OTHERWISE, THE THRUST WASHER COULD BREAK WHEN YOU PLACE THE VALVE HOUSING ONTO THE GEAR HOUSING. A BROKEN THRUST WASHER COULD CAUSE UNCONTROLLABLE STEERING, POSSIBLY RESULTING IN AN ACCIDENT.



Figure 117

install second
thrust washer

18. When the ten minute compression time has lapsed, remove the compression tool from the valve sleeve (13). Apply more grease to the valve sleeve seals (11 and 12), and grease the thrust washer face on the end of the valve sleeve without the drive slots (FIG. 117). Place the second thrust washer (9) onto this face (FIG. 118).



Figure 118

WARNING

WARNING: THIS THRUST WASHER MUST BE SECURELY IN PLACE ON THE VALVE SLEEVE. IF IT IS NOT, IT CAN BREAK AND CAUSE UNCONTROLLABLE STEERING, POSSIBLY RESULTING IN AN ACCIDENT.

assemble valve sleeve into valve housing

19. Locate the timing mark on the valve sleeve (13), a faint, punched mark on the chamfered edge of the sleeve or an indented mark on the front face of the sleeve (FIG. 119). Make a corresponding mark on the front face with a felt marker if the edge is marked.

Assemble the valve sleeve (13), with the second thrust washer attached, into the valve housing (7) thrust-washer end first. When the valve sleeve is properly in place, the valve sleeve face should measure approximately .40 in. (10.2 mm) below the face of the valve housing at the sleeve cavity (FIG. 120).

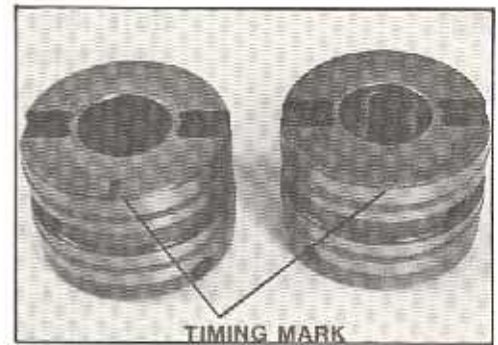


Figure 119

WARNING

WARNING: DO NOT FORCE THE VALVE SLEEVE DOWN INTO THE VALVE HOUSING. MAKE SURE THE VALVE SLEEVE SEAL RINGS ARE COMPRESSED. MISASSEMBLY OR INCORRECT MEASUREMENT MAY CAUSE THE THRUST WASHERS OR THRUST BEARING TO BREAK DURING GEAR OPERATION. THIS WILL RESULT IN UNCONTROLLABLE STEERING.

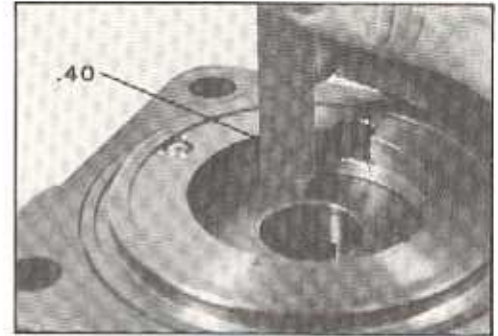


Figure 120

position rack piston and rotate worm shaft/input shaft assembly

20. Position the rack piston (17) so that it is flush with the open end of the gear housing. If the rack piston has the automatic poppet adjuster and sleeve assembly (19A) position the rack in the shaft housing so that end of adjuster seat and poppet is inside of the housing face. Rotate the worm shaft/input shaft assembly (14) until it extends out of the rack piston as far as it will go. (FIG. 121).



Figure 121

WARNING

WARNING: THE WORM SHAFT/INPUT SHAFT ASSEMBLY AND VALVE SLEEVE ASSEMBLY IS ASSEMBLED AND SOLD AS A MATCHED SET. USE ONLY MATCHED SETS FOR REPLACEMENT. NEVER MATE AN OLD VALVE SLEEVE WITH A NEW WORM SHAFT, OR AN OLD WORM SHAFT WITH A NEW VALVE SLEEVE. TO DO EITHER MAY RESULT IN DAMAGE TO THE GEAR OR INJURY TO THE DRIVER DURING OPERATION.

install valve assembly onto worm shaft/input shaft assembly

21. Locate the scribed timing marks on the worm shaft/input shaft assembly (14) (FIG. 122) and valve sleeve (13).

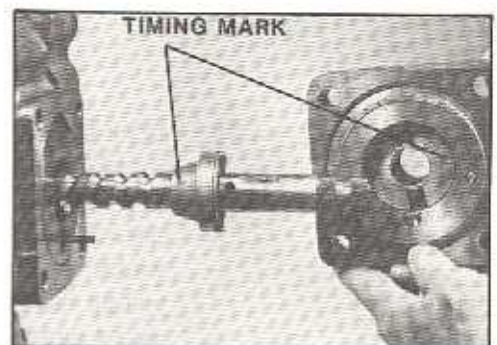


Figure 122

Next, grasp the valve housing (7) and valve sleeve (13) as an assembly, with your thumbs on the valve housing and your fingers applying pressure on the valve sleeve to keep it in the valve housing (FIG. 123).

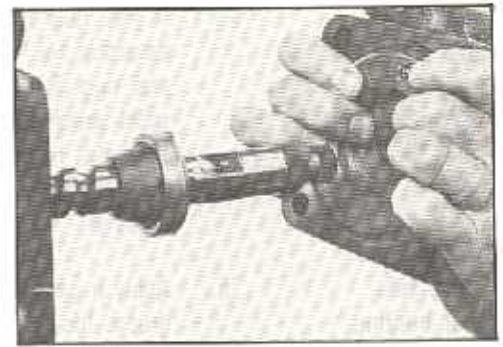


Figure 123

Align the previously located timing marks and place the valve housing and valve sleeve as an assembly onto the input shaft end of the worm shaft/input shaft until the drive ring lugs on assembly (14) are fully engaged in the valve sleeve lug slots (FIG. 124).



Figure 124

NOTE

NOTE: Valve sleeves are identified and matched to a right or left hand lead of the worm screw. If the screw has a right hand thread (that is, goes into the rack piston when turned clockwise), the valve sleeve will have the letter "R" stamped between the seal lands. For a left hand worm lead (which will come out of the rack piston when turned clockwise) the mating valve sleeve has no identifying letter or has the letter "L" stamped between the seal lands.

WARNING

WARNING: IF YOU PLACE AN INCORRECT VALVE SLEEVE ON A WORM AND ASSEMBLE THIS INTO THE GEAR, THE GEAR WILL NOT FUNCTION PROPERLY. INSTEAD, THE MECHANISM WILL JERK THE STEERING WHEEL WITH SUCH FORCE, THAT IT COULD INJURE THE DRIVER.

finish valve housing installation

22. Maintain pressure on the valve end of the valve housing to insure continued engagement of the drive lugs and thrust bearing package. While maintaining this pressure, rotate the valve housing to align its poppet recess (if equipped) with the poppet in the rack piston (17) (FIG. 125). The automatic bleed passage way must also be aligned if so equipped. While maintaining pressure, rotate the input shaft to bring the valve housing into contact with the gear housing face.

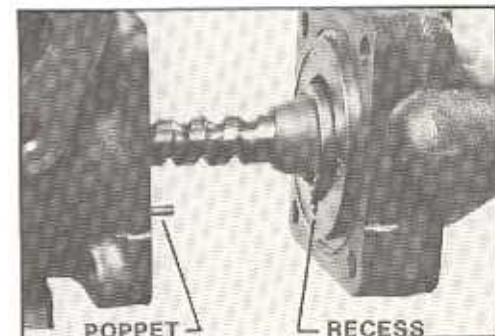


Figure 125

NOTE

NOTE: If a line was scribed across the valve housing and gear housing before disassembly, as recommended, use the line for correct valve housing positioning.

install valve housing bolts

23. Install the four valve housing bolts (1) into the valve housing (7). Alternately torque bolts to a final torque of 45-55 ft. lbs. (61-75 N m) if dry, or 33-40 ft. lbs. (45-54 N m) if lubricated (FIG. 126). A 5/8 inch socket required.



Figure 126

install relief
valve

24. If your gear is equipped with a relief valve (58), assemble the new O-ring (59), the new Teflon seal ring (60), and the new O-ring (15) onto the relief valve (FIG. 127). Install the relief valve into the valve housing (71) and torque it to 25.35 ft. lbs. (34.48 N m). (FIG. 128). One inch socket required.

grease side
cover bearing

25. Apply a generous amount of clean wheel bearing grease (do not substitute another type of grease) to the bearing race or bearing assembly inside the side cover (50).

CAUTION

CAUTION: Use only wheel bearing grease. This bearing is sealed and will receive no lubrication from the hydraulic fluid in the gear. Without wheel bearing grease, the bearing could wear prematurely.

assemble side
cover bearing rolls

26. If the bearing has loose (uncaged) rolls assemble the 39 bearing rolls into the side cover bearing race (FIG. 129).

CAUTION

CAUTION: Apply wheel bearing grease to these rolls to retain them in the bearing race.

assemble adjusting
screw and retainer

27. If the adjusting screw (43) has been removed from the sector shaft (42), clamp the sector shaft into a soft-faced vise by gripping the serrated end. Coat the expanded end of the new adjusting screw with a suitable grade of wheel bearing grease and insert into recess in end of sector shaft. Thread a new sector shaft screw retainer (44) into the sector shaft and adjust to permit free rotation of sector shaft adjusting screw by hand without perceptible end play (.000 to .002 loose). Stake the new retainer (44) into the two slots provided using a suitable punch and again check freedom of adjusting screw movement and end play (FIG. 130).

WARNING

WARNING: USE CARE IN SECURELY STAKING THE RETAINER (44) INTO THE SECTOR SHAFT SLOTS. A RETAINER THAT IS BROKEN OR CRACKED DURING THE STAKING PROCEDURE MUST BE REPLACED AS IT COULD RESULT IN THE SECTOR SHAFT NOT BEING RETAINED AND THE LOSS OF MANUAL AND POWER STEERING CONTROL.

assemble steel
and Teflon
washer into
side cover

28. Assemble the steel backup washer (48) and then the new Teflon washer (47) into the side cover (50) bearing bore (FIG. 131).



Figure 127

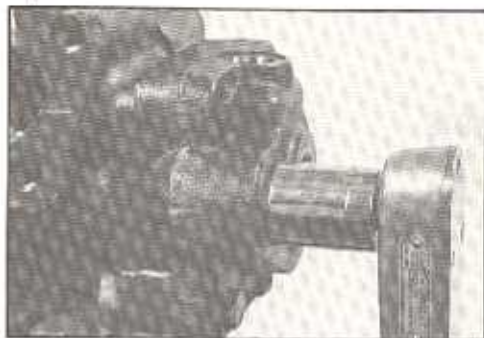


Figure 128

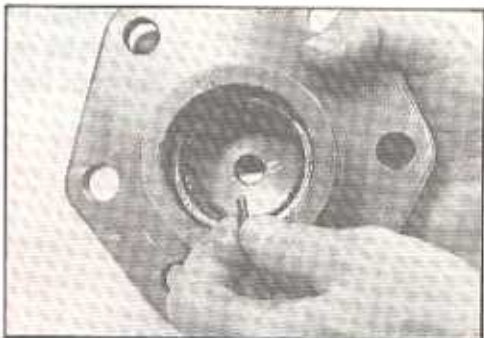


Figure 129



Figure 130



Figure 131

assemble
retaining ring
and seal

29. Assemble retaining ring (45) onto the side cover end of sector shaft (42). Assemble the two-piece seal (46) onto the end of the sector shaft about 1 inch (25.4 mm). The words "oil side" on the seal must face toward the sector shaft. SEE FIGURE 132.

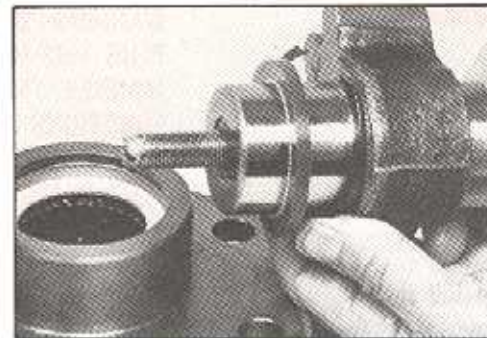


Figure 132

CAUTION

CAUTION: Be sure the two piece seal and the side cover bearing rolls remain correctly assembled and that the vent plug (52) has been removed during these procedures.

install sector
shaft into
side cover

30. Be sure the side cover bearing, the sector shaft bearing diameter and seal are well greased, then insert sector shaft (42) assembly into the side cover (50) bearing only until the shaft will retain the loose side cover bearing rolls in place (about 8 turns of adjusting screw). Slowly and carefully work the two pieces seal (46) down the sector shaft and squarely into the side cover until it is past the retaining ring groove. Then work the retaining ring (45) into the retaining ring groove. Use an appropriate blunt end punch or punches (FIG. 133). Carefully turn the adjusting screw (43) through side cover until it reaches solid height then back screw on turn, so that the side cover rotates freely on sector shaft (FIG. 134).



Figure 133



Figure 134



Figure 135

install jam nut

31. Install the sector shaft adjusting screw jam nut (51) onto the sector shaft adjusting screw (43) a few threads (FIG. 135). Final adjustment will be made later.

assemble vent plug

32. Press the vent plug (52) into the hole provided in the side cover (50) until the plug is flush (FIG. 136).

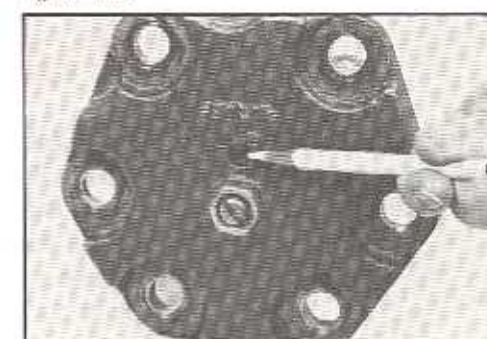


Figure 136

WARNING

WARNING: DO NOT WELD OR OTHERWISE PLUG THIS HOLE IN ANY PERMANENT MANNER. THIS IS A SAFETY VENT WHICH FUNCTIONS ONLY IF THE SIDE COVER SHAFT SEAL FAILS. IF THE SEAL FAILS AND THE PLUG CANNOT VENT, THE STEERING GEAR MAY LOCKUP OR OTHERWISE MALFUNCTION.

install side
cover gasket

33. Apply clean grease to the new side cover gasket (49), and assemble it onto the side cover (50) (FIG. 137). Apply enough grease to hold the gasket in place.



Figure 137

center rack
piston

34. There are four teeth on the rack piston (17). Position the rack piston so that the tooth space identified by the pencil in FIG. 138 (it is the space between the second and third teeth) is in the center of the sector shaft opening (FIG. 139). This will center the rack piston in the opening.



Figure 138

make initial worm
preload adjustment

35. With the rack piston (17) in its center position,, torque the worm shaft/input shaft adjusting screw (40) using a 1/4 inch Allen wrench socket into solid height [10 to 15 ft. lbs. (13.6 to 20.3 N m)]. Then loosen the adjusting screw 1/4 to 1/2 turn and note torque required to rotate worm shaft/input shaft (14) through 90° each side of center, using an 11/16 inch or 3/4 inch 12 point socket and an appropriate torque wrench (FIG. 140). Loosen adjusting screw if noted torque exceeds 15 in. lbs. (1.7 N m). Return rack piston to center position.



Figure 139

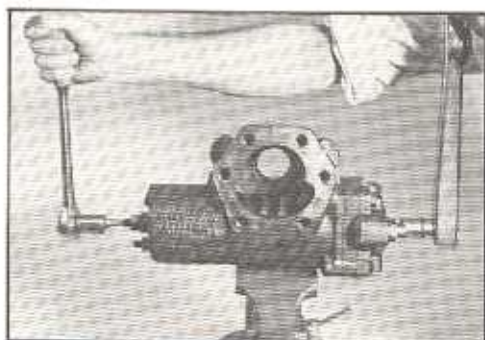


Figure 140

WARNING

WARNING: IF THE RACK PISTON IS NOT CENTERED WHEN SECTOR SHAFT IS INSTALLED, GEAR TRAVEL WILL BE SEVERELY LIMITED IN ONE DIRECTION. THIS COULD RESULT IN AN ACCIDENT.

install sector shaft
and side cover
into housing

36. Clean off any old tape on the sector shaft (43) serrations. Retape the serrations and bolt groove with one layer of masking tape. Install the sector shaft and side cover (50) into the gear housing (30) as an assembly. Make sure that the center tooth of the sector shaft engages the center space (between the second and third teeth) of the rack piston (FIG. 141).



Figure 141

WARNING

WARNING: AS YOU PLACE THE SECTOR SHAFT THROUGH THE HOUSING BEARING (32), DO NOT KNOCK ANY OF THE BEARING ROLLS OUT OF THE BEARING RACE. DO NOT PINCH THE SIDE COVER GASKET (49). IF YOU DO EITHER, THE BEARING OR SEAL MAY PREMATURELY FAIL, AND THIS COULD RESULT IN A LOSS OF POWER STEERING ASSIST.

install side
cover bolts

37. Install the six special side cover bolts (53) into the side cover (50). Alternately torque the bolts using a cross over sequence to a final torque of 150-170 ft. lbs. (203-230 N m) if dry, or 108-128 ft. lbs. (146-174 N m) if lubricated (FIG. 142). 13/16 inch socket required.

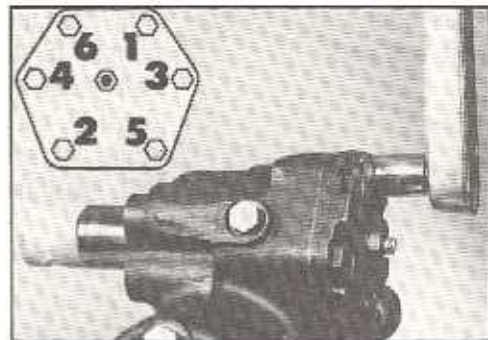


Figure 142



Figure 143

install seal,
washers and
retaining ring

38. Grease and assemble a new two piece seal (33) on to the sector shaft (42) so that the words "Oil Side" on the seal are toward the shaft bearing (32), then the Teflon back up washer (34) and the steel washer (35) with reduced outside diameter facing away from the housing (FIG. 143). Use installation tool J26815 to install these parts (FIG. 144). Install retaining ring (36) using a screwdriver to seat it in the housing ring groove (FIG. 145).



Figure 144

WARNING

WARNING: THE WORDS "OIL SIDE" MUST BE TOWARD THE BEARING, IF NOT, THE SEAL WILL NOT FUNCTION, AND A LOSS OF POWER STEERING ASSIST MAY OCCUR.



Figure 145

pack with grease
and install dirt
and water seal

39. Pack the cavity around the seal area of the sector shaft (42) with high temperature industrial grease per Ross specification 045231, *Mobil temp 1 or 2 or equivalent. Install a new dirt and water seal (37) using a suitable blunt-ended drift (FIG. 146).



Figure 146

install input
shaft seal pack

40. Apply clean grease to the new input shaft seal assembly (6 and 5) and to the worm shaft/input shaft. Install the new two-piece input shaft seal (6 and 5), flat side out, and the steel backup washer (4), using seal driving tool J26653 (FIG. 147). Install the retaining ring (3) (FIG. 148).



Figure 147

pack with grease,
install dirt and
water seal

41. Pack the area around the input shaft with clean high temperature industrial grease per Ross specification 045231, Mobil Temp 1 or 2 or equivalent, and install the new dirt and water seal (2), with part number facing out, using seal driving tool J26654 or suitable blunt-ended drift (FIG. 149). If the dirt and water seal has a rim, it should be pressed against the valve housing face. If the seal does not have a rim, the seal should be pressed in flush with the valve housing face.

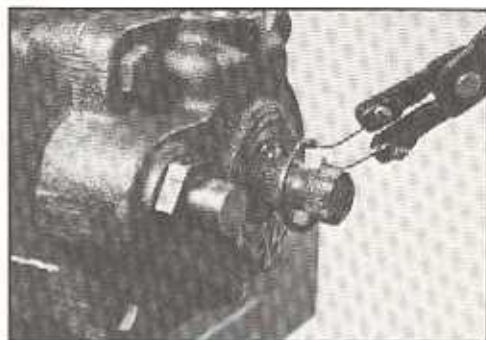


Figure 148

install manual
bleed screw, if
equipped

42. If your gear is equipped with the manual bleed screw (54), install it into the gear housing (30) and torque it to 27-33 in. lbs. (3.1-3.7 N m) (FIG. 150). 5/16 inch socket required.



Figure 149

CAUTION

CAUTION: For next step, make sure gear is very secure in vise.

install automatic
bleed screw, if
equipped

43. If your gear is equipped with the automatic bleed screw (54A), position the steering gear in a soft jawed vise so that the cylinder bore axis is vertical and the input shaft is pointing down. Then, install the spring (56), the special pin (55) spherical end first, and the automatic bleed screw (54A) into the housing (30) (FIG. 151). Torque the screw to 16-20 ft. lbs. (22-27 N m). 1/2 inch Hex or E-10 Torx socket required.

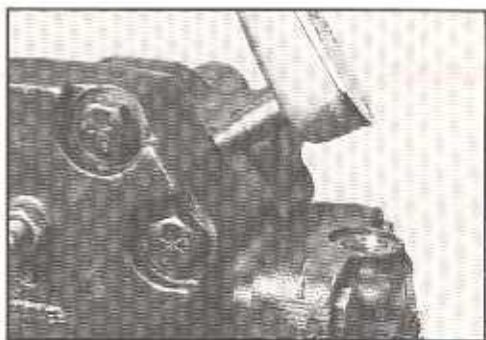


Figure 150

WARNING

WARNING: IF THE AUTOMATIC BLEED ASSEMBLY IS IMPROPERLY ASSEMBLED, THERE MAY BE A LOSS OF POWER STEERING IN ONE DIRECTION.

This completes assembly of the HFB52 steering gear. Before you install the gear onto the vehicle, make the final adjustments described below. All ports should be plugged until unit is installed on vehicle.



Figure 151

Final Adjustment

center steering gear

1. To center the steering gear, rotate worm shaft/input shaft (14) until the timing mark on the end of sector shaft (42) is perpendicular to the worm shaft/input shaft (FIG. 152). A 12 point 11/16 or 3/4 box end or socket required.

CAUTION

CAUTION: Do not allow the worm shaft/input shaft on a steering gear with the automatic poppet adjustment feature to rotate more than 1.5 revolutions from the center position while steering gear is not completely installed in the vehicle as this could disrupt the poppet adjustment achieved at initial installation or the poppet adjustor seat and sleeve assembly that has been set for automatic poppet adjustment after installation.

NOTE

NOTE: Initial worm preload was accomplished in assembly procedure 35, page 43, before assembly of sector shaft (42).

tighten adjusting screw

2. Tighten sector shaft adjusting screw (43) to provide 25 to 30 inch lbs. (2.8 to 3.4 N m) of torque required to rotate the worm shaft/input shaft (14) through 180° each side of center (FIG. 153).

NOTE

NOTE: This procedure will properly mesh and seat the rack piston teeth and sector shaft teeth for final adjustments.

loosen adjusting screw and note torque

3. Loosen sector shaft adjusting screw (43) one turn and note maximum torque required to rotate the worm shaft/input shaft (14) through 180° each side of center.

adjust adjusting screw

4. Adjust sector shaft adjusting screw (43) to increase maximum torque noted in procedure #3 by 2 to 4 inch lbs. (.23 to .45 N m). Torque jam nut (51) using a 3/4 inch socket, to 40 to 45 ft. lbs. (54 to 61 N m) and check worm shaft/input shaft torque again. Re-adjust if worm shaft/input shaft torque exceeds 20 inch lbs. (2.3 N m).

adjust worm shaft/input shaft adjusting screw

5. Adjust worm shaft/input shaft adjusting screw (40), a 1/4 inch Allen wrench or screwdriver required, to increase maximum worm shaft/input shaft (14) torque noted in procedure #4 by 10 to 15 inch lbs. (1.1 to 1.7 N m). Torque sealing nut (41) to 45 ± 5 ft. lbs. (61 ± 7 N m) using a 7/8 inch socket and check worm shaft/input shaft torque again. Readjust if worm shaft/input shaft torque exceeds 35 inch lbs. (4.0 N m). (FIG. 154).

This completes the final adjustments of the HFB52 gear to be made before it is installed into the vehicle's steering system. Install the gear by following instructions in the vehicle shop manual. Then follow the succeeding sections of this service manual (HFB52) on "HYDRAULIC FLUID" and "FILLING AND AIR BLEEDING THE SYSTEM" which also includes instructions for adjustment of the optional adjustable poppet valve.

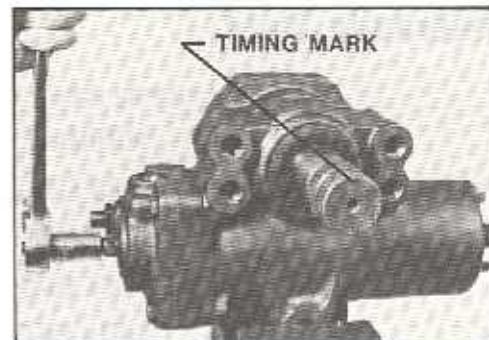


Figure 152



Figure 153

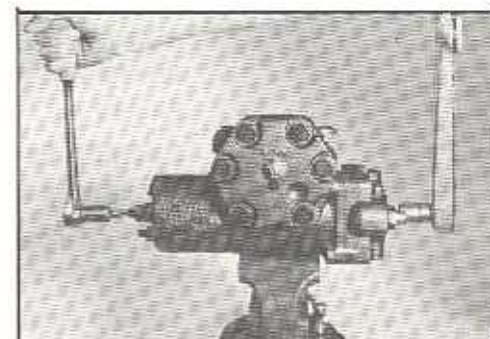


Figure 154

Hydraulic Fluid

The steering system should be kept filled with one of the following fluids;

AUTOMATIC TRANSMISSION FLUID TYPE "E" or "F"

FORD SPEC. M2C138CJ

AUTOMATIC TRANSMISSION FLUID DEXRON II

MACK EO-K2 ENGINE OIL

SHELL ROTELLA T SAE 30

MOBIL SAE 10W30

ASHLAND SAE 10W40

UNION SAE 10W40

TEXACO SAE 10W40

TEXACO SAE 15W40

MOBIL SAE 10W40

UNICAL GAURDOL SAE 15W40

UNICAL GAURDOL SAE 30

ESSOLUBE SAE 15W40

CHEVERON SAE 10W40

EMERY FRIGID-GO-OW-02 SYNTHETIC

WARNING: COMPLETELY FLUSH THE STEERING SYSTEM WITH ONE OF THE RECOMMENDED FLUIDS ABOVE ONLY. DO NOT MIX OIL TYPES. ANY MIXTURE OR ANY UNAPPROVED OIL COULD LEAD TO SEAL DETERIORATION AND LEAKS. A LEAK COULD ULTIMATELY CAUSE THE LOSS OF FLUID, WHICH COULD RESULT IN A LOSS OF POWER STEERING ASSIST.

Filling and Air Bleeding the System

CAUTION: For steps 1 and 2, do not turn the steering wheel. Otherwise, air may be induced into the system.

1. Fill the reservoir nearly full. Crank the engine for 10 seconds without, if possible, allowing it to start. If the engine does start, shut it off immediately. Check and refill the reservoir. Repeat at least three times, each time checking and refilling the reservoir.

CAUTION: Do not allow the fluid to drop significantly or run out of the reservoir. This may induce air into the system.

2. Start the engine and let it idle for 2 minutes. Shut the engine off and check the fluid level in the reservoir.
3. Start the engine again. Steer the vehicle from full left to full right turn several times. Add fluid, as necessary, to the fill line on the dipstick.

NOTE: Poppets, if equipped on the gear, must relieve pressure at full right and full left turns to aid in the removing of air from (air bleeding) the system. At this time, make sure that the one adjustable poppet is properly adjusted. If it is not, adjust it in accordance with "Poppet Valve Adjustment", section 4 (page 17) and repeat step 3. See page 53 for automatic type poppet procedures.

The above procedures should remove all the air from the steering system, unless the gear is mounted in an inverted position and is equipped with the manual bleed screw (54) (See FIG. 149, Page 45). If this is so, refer to step 4.

4. Remove the air from a gear mounted in an inverted position and equipped with a manual bleed screw (54) by following steps 1, 2 and 3 above. Then, with the engine idling, steer the gear from full left turn to full right turn several times. Loosen the manual bleed screw about one turn, with the steering gear in neutral (no steering action), allowing air and aerated fluid to "bleed out" around the bleed screw until only clear (non aerated) fluid is bleeding out then close the bleed screw. 5/16 inch socket required. Check and refill reservoir.

Repeat this procedure 3 or 4 times starting with the steering maneuver with bleed screw closed, until only clear (non aerated) fluid is discharged when bleed screw is loosened. Torque the manual bleed screw to 27.33 in. lbs. (3.1 3.7 N m). Check and refill reservoir.

CAUTION: Do not turn steering wheel with bleed screw loosened as this could induce air into the system.

WARNING: DO NOT LOOSEN OR REMOVE THE AUTOMATIC BLEED SCREW (54A) (SEE FIG. 151) WHEN THE STEERING GEAR IS MOUNTED ON THE VEHICLE. IF IT IS LOOSENED OR REMOVED, THERE MAY BE A LOSS OF POWER STEERING ASSIST IN ONE DIRECTION OF TURN. THE AUTOMATIC BLEED SCREW CAN BE IDENTIFIED BY ITS 1/2" HEX HEAD OR E-10 TORX HEAD. IF AUTOMATIC BLEED SCREW COMPONENTS ARE INADVERTENTLY REMOVED, INSTALL THE SPRING, THEN THE SPECIAL PIN, SPHERICAL END FIRST INTO HOUSING. ASSEMBLE AND TORQUE BLEED SCREW TO 16-20 FT. LBS. (22-27 N m).

Warnings for Proper Steering Gear Operation

WARNING: DO NOT WELD, BRAZE, OR SOLDER ANY STEERING GEAR OR SYSTEM ARM COMPONENTS.

WARNING: MAXIMUM FLOW UNDER ANY CONDITIONS MUST NOT EXCEED 6 GPM (22.7 Liters/Min).

WARNING: MAXIMUM OPERATING PRESSURE MUST NOT EXCEED 2000 PSI (137.9 bar).

WARNING: ALWAYS CAREFULLY INSPECT ANY STEERING COMPONENT WHICH HAS BEEN (OR IS SUSPECTED TO HAVE BEEN) SUBJECTED TO IMPACT. REPLACE ANY DAMAGED OR QUESTIONABLE COMPONENT.

Steering System Maintenance Tips

- Prevent internal bottoming of the steering gear. Carefully check axle stops to be sure that they meet the manufacturer's specifications.

- Regularly check the fluid and the fluid level in the power steering reservoir.

- Keep tires inflated to correct pressure.

- Always use a puller, never a hammer or torch, to remove pitman arms.

- Investigate and immediately correct the cause of any play, rattle, or shimmy in any part of the steering linkage or steering mechanism.

- Remove the cause of steering column misalignment.

- Encourage all drivers to report any malfunctions or accidents that could have damaged steering components.

- Do not attempt to weld any broken steering component. Replace the component with original equipment only.

- Do not cold straighten, hot straighten, or bend any steering system component.

- Always clean off around the reservoir filler cap before you remove it. Prevent dirt or other foreign matter from entering the hydraulic systems.

- Investigate and correct any external leaks, no matter how minor.

- Replace filters and pumps in compliance with specification.

- If extended stationary use of vehicle is developing excessive hydraulic fluid temperatures consult vehicle manufacturer for auxiliary cooling method.

- Maintain grease pack applied behind the input and output shaft's dirt and water seal as a general maintenance procedure.

Special Procedures for Automatic Poppet Adjustor Seat and Sleeve Assembly Type Steering Gears

REF: Page 19C & 19D "Alternate Construction — Automatic Poppet Adjustor Seat and Sleeve Assembly (19A), Poppet Stop Screw (39A) and O-Ring (62)"

HFB52 steering gears that utilize the automatic poppet adjustor seat and sleeve assembly (19A) will have both poppets automatically positioned or set to the axle stops when the steering gear is initially installed in the vehicle. Any readjustment of the axle stops for less travel will require that the steering gear and at least one automatic poppet adjustor seat and sleeve assembly (19A) be disassembled and the poppet adjustor seats be reset for automatic poppet adjustment when again installed in a vehicle. The automatic poppet adjustor seats must be reset for automatic adjustment if the steering gear is to be installed in a different vehicle from which it was removed.

CAUTION

CAUTION: A steering gear that is equipped with the automatically set poppets must not be rotated more than 1.5 steering wheel (input shaft) revolutions from the straight ahead position after being disconnected from the steering linkage such that the axle stops are not in effect. Rotating the steering wheel beyond the travel that was controlled by the axle stops will reset the poppet adjustments to a position that will make the poppets inoperative for the installation the steering gear was disconnected from.

reset automatic
poppet adjustor
seat and sleeve
assembly

1. To reset the automatic poppet adjustor seat and sleeve assembly (19A) that has been removed from the rack piston, it must be reversed and screwed loosely into a special fixture or into its threaded hole in the rack piston for full thread length so that the end with the retaining ring is out. SEE FIGURE 155. Press in the adjustor seat into the adjustor sleeve with a force of 500-2500 lbs. (227-1134 KG) until the retaining ring on the adjustor seat bottoms against the adjustor sleeve. SEE FIGURES 156, 157. Remove the adjustor seat and sleeve assembly from the fixture or rack piston and it is ready for proper assembly into the rack piston.

NOTE

NOTE: If one poppet adjustor seat and sleeve assembly (19A) was left in rack piston, it can be reset for automatic poppet adjustment by inserting a 3/8 inch (9.5 mm) drill rod down through the poppet seat hole at the opposite end of the rack piston and against the adjustor seat to press the seat in until it bottoms against the adjustor sleeve.



Figure 155



Figure 156



Figure 157

Positioning Automatic Poppets After Installing Steering Gear Into Vehicle

CAUTION

CAUTION: The axle stops and all steering linkage must be in accordance with vehicle manufacturers specifications and the pitman arm correctly aligned on the steering gear sector shaft or the poppets may be automatically set incorrectly and require disassembly of the steering gear to rectify.

position poppet to axle stop

1. This procedure assumes that steering gear automatic poppet adjustor seat and sleeve assembly (19A) is set or has been reset for automatic poppet adjustment. With the engine at idle and the vehicle unloaded and moving slowly straight ahead, turn steering wheel toward full travel in one direction until the steering gear firmly bottoms against the axle stops. Maximum input torque to be applied during this procedure is 300 in. lb. (33.9 N m) or 30 lb. (13.6 kg) rim pull on a 20 in. (508 mm) diameter steering wheel. This will automatically position the poppet adjustor seat and sleeve assembly in relation to the axle stop.

position other poppet

2. Follow the same procedure while turning the steering wheel in the other direction. The poppet valves are now positioned to trip and reduce pressure as the steered wheels approach the axle stops in either direction.



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